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Reminiscences.

THE passing of Mr. George Offor, the only centenarian, so far as we are aware, of the British electric lighting industry, recalls to mind many most interesting conversations that present and past editors of the ELECTRICAL REVIEW had with him in these offices in the later years of his connection with electricity supply matters, before his great age confined him to his home at Sydenham. He was a most genial man and always ready with an abundance of reminiscences when well past the 'eighties. So impressed was he with some of his recollections that it was his desire to place many of them on record in printed form. For some years he was actually engaged upon their compilation, and at that time it was our privilege to lend him some of the early volumes of the ELECTRICAL REVIEW, these being the only source from which he could verify facts and experiences or recall forgotten parts of outstanding episodes. What he wrote may never see the light of day.

It has been often said that there is a need for some of our veterans or others who have long memories to prepare a history of past events, but again and again when the matter has been seriously considered the conclusion has been reached that the labour involved would be far greater than would be justified by the demand that in actual fact exists for a work which might be to a large extent very personal in places. Mr. Offor, for example, though he played a somewhat important part in the early days of electric lighting and electric lighting legislation, will always be regarded by some of us who knew his life from his own lips, as a man who never came into his own or reaped anything like the due reward of his efforts. He was so familiar with the finance of the electrical industry that had he been twenty years younger when the recent legislation was before the country, he would have been able to share in the profits of many an electricity scheme during the past year or two. That he did not do so is due to his having been born out of due time. His knowledge of electrical affairs and his early energies and activities of one kind and another would

doubtless have borne fruit to his personal advantage. He was not only a man of energy and enthusiasm for things in which he really believed—he was a consistent opponent of municipal electrical trading and one of the earliest writers to hammer home the importance of soundness in electricity supply finance and the necessity for providing for obsolescence of plant in addition to depreciation. Experience has shown the correctness of these latter views in connection with municipal enterprise. He was one of the first to see the necessity for educating the public regarding the merits of electricity in the household by publishing a little magazine expressly for that purpose.

But if we begin to indulge in reminiscence, faces crowd in upon us, and statements in such multitudinous variety compete for re-hearing, that we have to pull ourselves up and reach, if we can, one general conclusion from the recollections of the centenarian who has so recently passed on, and from our own independent observations of the doings, sayings, and undertakings of the great company of other pioneers who have preceded him or are still with us. That conclusion is this: the complete record if there were one amongst us qualified to attempt it might have to contain things which could not be printed when they happened and would only interest a few now, while some are best forgotten altogether. A complete history of the electrical industry, including its scientific, engineering, commercial and financial details and varying aspects and stages, would be nothing short of a colossal work.

There would be some value in a sort of "Dictionary of Electrical Dates"—that is frequently required—and abounding interest for some of us would exist in a collection of brief stories of amusing, startling, and perhaps even discreditable electrical occurrences—incidents, successes, achievements, failures, which have helped to make up the intimacies and the humour of the past. Every leading man alive to-day, and some who have had no desire to lead, has stowed away in his series of brain records much that would either edify or amuse, but for obvious reasons many things affecting other people's good names cannot be told in print, interesting as they may be when related in a convention or other social circle. There are the many romantic stages in the origin and development of electrical companies, the interesting steps characteristic of unorganised industry, and the more interesting schemes, effective and ineffective, which have been born, and perhaps have died, in secret conclave, in these days of close co-operative organisation which cause some people so many headaches.

Weekly papers are too much occupied in telling the story of events as they are happening to find it wise to devote much attention to history and reminiscence. The individual stories of particular men might, as we have indicated, be very fascinating, but for anything more than that it might be found necessary to resort to the advance subscription list of a hundred years ago when the discourses of the reverend so-and-so were published under the joint guarantee of so many hundred generous public and other supporters whose names were inscribed following the preface to the book.

Generating Capacity in the United States.

A revision of all the data available by the *Electrical World* leads to the conclusion that at the commencement of 1928 the public electricity supply undertakings of the United States had a total installed capacity of 29,629,000 kVA; there were 2,806 companies and municipalities operating plant, in addition to 1,644 systems which used purchased energy exclusively. Of the 4,450 systems, 2,477 were owned by private companies and 1,973 by municipalities (the latter owning comparatively little generating plant).

Whilst the population of the United States is nearly three times that of this country, the number of electricity supply undertakings is nearly seven times as many as ours; and the number of authorities generating electricity for public supply is 5½ times as great.

Evidently the United States is in worse case than this country from the point of view of multiplicity of generating stations. Mr. Samuel Insull came here and advised us to concentrate our generating plant; it seems desirable that Lord Weir, say, should go there and reciprocate that friendly action! However, it must be admitted that the United States is making good progress, for two years ago we pointed out that it possessed 6,000 electricity supply undertakings and 4,800 generating stations (Electrical Review, April 16th, 1926, p. 605); a reduction of 40 per cent. in two years is quick work. Probably it means that a good many very small power stations have been shut down, bulk supply being substituted.

The Electrical Conductivity of Cotton.

The research work conducted by the British Cotton Industry Research Association with regard to the electrical conductivity of cotton is fraught with great interest to electrical engineers. A special investigation was undertaken by the Research Association because of complaints that it was difficult to meet the standard required by the electric cable industry, and it was found that the insulating power of raw cotton could be increased about twenty-fold merely by boiling with water, the treatment having the effect of extracting the mineral matter which in a moist environment would make the cotton a better conductor. It was also shown that direct dyes, which are often salts of strong acids, and therefore good conductors of electricity, are quite unsuitable for use on coloured insulating yarns. Basic dyes, on the other hand, have been proved actually to improve the insulation resistance of yarns. Apart from the demands of the electrical industry with regard to conductivity, it is worthy of note that electric light has been of considerable value in research work and has assisted the spinners to produce cotton yarn that will not be affected by intense light. It is well known that intense tropical light "tenders" cotton goods to an extent which considerably reduces their useful life. Whilst this action may be ignored with most classes of goods, it becomes of great importance with aircraft and other fabrics subject to continuous outdoor exposure. An investigation, in which powerful artificial sources of light (the mercury and carbon arcs) and sunlight in England and abroad have been employed, has shown that cotton yarns become more resistant to light as the yarn becomes coarser and as the twist is increased. In attempting to find a treatment which would reduce the light sensitivity of cotton, it has been shown that, in general, direct and vat dyes have very little influence on the rate of tendering, while many basic dyes actually increase the sensitivity. Other treatments which have been tested are, however, capable of protecting cotton exposed to intense light, to such an extent that the life of the material is prolonged three or four times. It is clear that electricity plays an important part in the cotton industry, quite apart from its use as a motive power.

Railway Electrification.

The subject of railway electrification, which has figured prominently in our pages recently, is one of the most important matters with which the electrical industry is concerned, and though the directors of our main-line railways have shelved the question since the "grouping system" came into force, we confidently assert that the time is not far distant when they will have to tackle it seriously. Other countries are making steady progress with the work, and the conditions in Great Britain are at least as favourable to its success as elsewhere. Moreover, the results obtained in the past have invariably justified the conversion, so far as our suburban systems are concerned, and have brought to light additional advantages and economies thereby made possible which had not been fully foreseen. In this connection the results of the enterprising policy of the London Southern railways, summarised elsewhere in this issue, will be found exceptionally interesting.

French Railway Electrification.

Considerable progress has been made in the work of electrifying the Midi Railway; 480 miles of single and double track is at present in operation, out of a total of 2,169 miles projected.

By CHAS. J. WEBB, [A.I.A.E.

IT was in 1902 that the Compagnie des Chemins de Fer du Midi first commenced the work of electrifying its railway system, a start being made with the narrow-gauge line between Villefranche-de-Conflans and Bourg-Madame. By 1913 the company's electrification programme extended to nearly 600 miles, and by way of experiment a 12,000-V, 16-cycle, single-phase system was installed on the Villefranche-Ille section of the Perpignan-Villefranche line, which was supplied from the sub-station at Villefranche, where a three-phase, 25,000-V, 25-cycle supply was received from the La Cassagne power station.

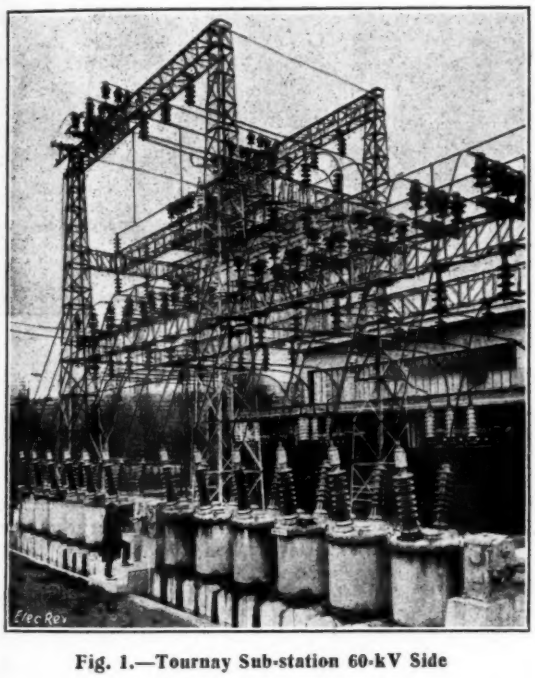


Fig. 1.—Tournay Sub-station 60-kV Side

The experiment proved successful, and the undertaking proceeded to electrify the whole length of the Perpignan-Villefranche line on its system, and, to furnish the necessary power, established a 4,400-h.p. hydro-electric station in the Tet Valley. The supply from this station is single-phase, $16\frac{2}{3}$ cycles, 13,000 V. The further electrification work put in hand included the Pau-Montréjeau section of the main line between Bayonne and Toulouse, and the branch lines from Montréjeau to Luchon, from Lannemezan to Arreau, from Tarbes to Bagnères-de-Bigorre, and from Lourdes to Pierrefitte. To provide the necessary power for these sections a hydro-electric station of 21,000 h.p. was erected at Soulom, near Pierrefitte, in the Upper Pyrenees, and plans for a second power station of 35,000 h.p. at Eget were prepared.

The outbreak of the war caused a suspension of all electrification work, and the power stations of the company were placed at the disposal of the Government for military purposes. During the war, although actual work was at a standstill, the company extended its electrification programme to just over 2,000 miles, and submitted a complete scheme to the French Ministry of Public Works. About the same time the Orleans Railway drew up plans for the electrification of over 1,800 miles of its system, the Paris, Lyons and Mediterranean Railway Co. doing the same with respect to nearly 1,400 miles. It was decided that the supply for the three railways should be uniform and at 1,500 V, except that in certain cases 3,000 volts could be adopted so long as the locomotives were so equipped that they could be used also on 1,500 V. For generation and transmission, 3-phase, 50 cycles had already been fixed. By October, 1922, electric trains operated at 1,500 V d.c. were running between Tarbes and Pau, and to-day no less than 480 miles of double and single track is in operation. Electrification work is also in progress on 68 miles of line, and preparations are in hand for the conversion of 446 miles, while a similar change in respect of 1,175 miles is projected, so that the total Midi programme extends to 2,169 miles, of which 508 miles is of double track.

All the power for the electrified lines of the Midi system is produced in hydro-electric stations at 60,000 V. Part of the output is transmitted at this pressure to convertor stations, and the remainder is stepped up to 150,000 V for transmission purposes, and reduced again to 60,000 V for supplying to the distributing systems. Some of the railway sections are equipped with 10,000-V lines fed from sub-stations on the 60,000-V mains for supplying power and lighting for the railway stations and the block-signalling system.

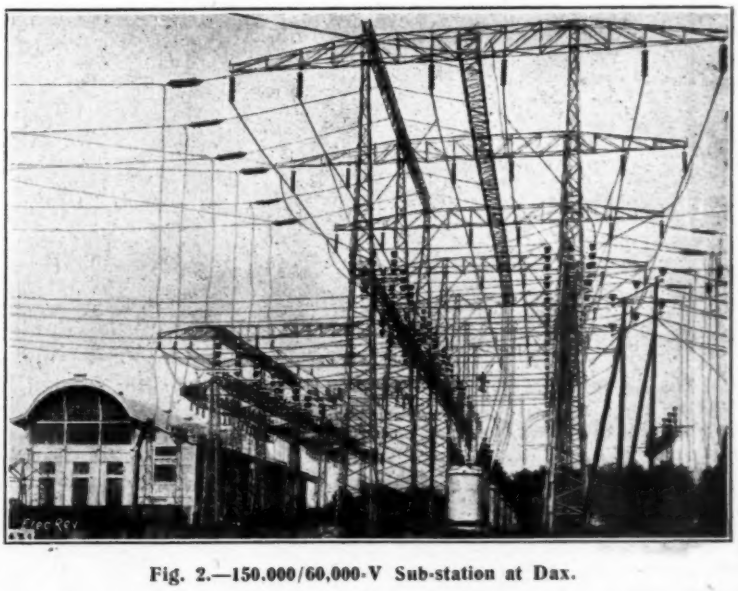


Fig. 2.—150,000/60,000-V Sub-station at Dax.

In addition to the La Cassagne and Fontpedrouse stations, which are eventually to be shut down or con-

verted into transformer sub-stations, the programme provides for the establishment of a total of eleven hydro-electric generating stations. Of these, four have already been completed, one is in course of construction, and plans are being prepared in respect of the other six. The stations already in operation are the Soulom, near Pierrefitte, the Eget, near Saint Lary, in the Upper

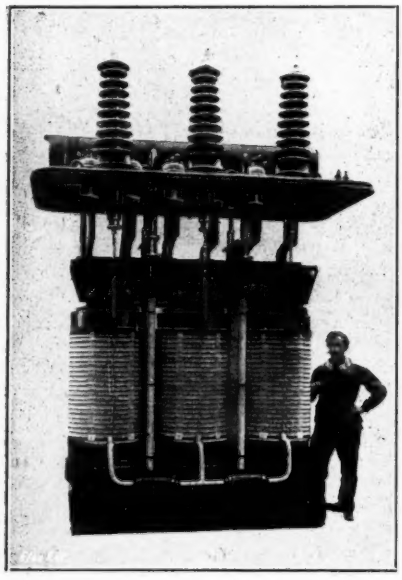


Fig. 3.—60,000/2 × 560-V, 3-phase Transformer.

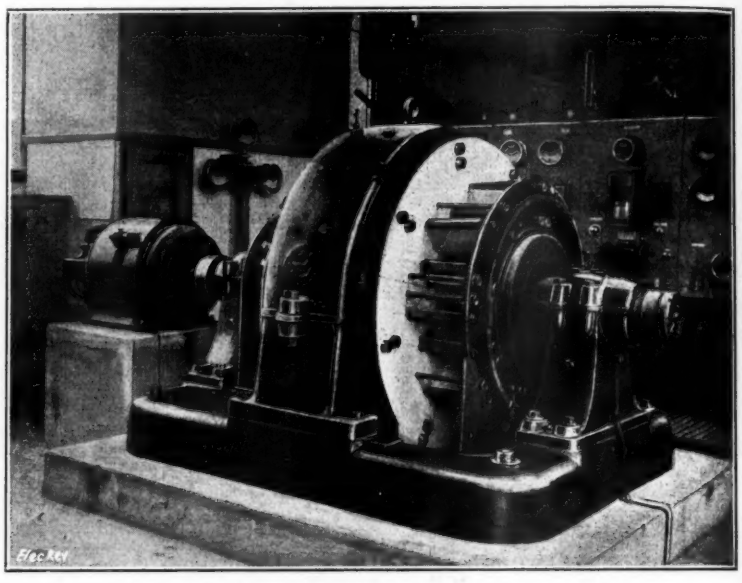


Fig. 4.—Interior of Traction Sub, showing 750-V Machine.

Pyrenees, and those at Houbat and Miegebat in the Ossau Valley of the Lower Pyrenees, where also the Artouste station is being erected. As for the six stations yet to be built, three will be located in the Upper Ariège valley and three in the Tet valley.

The main plant at the Soulom station, which utilises

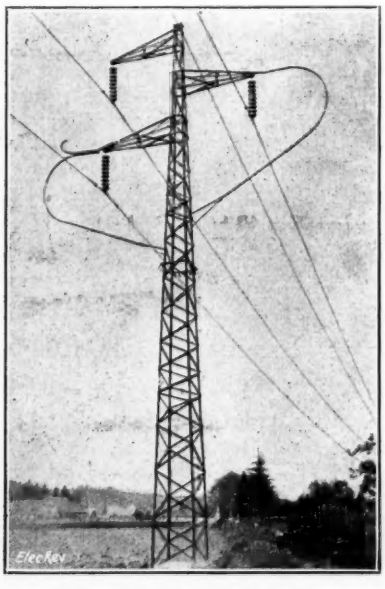


Fig. 5.—150,000-V Line Mast.

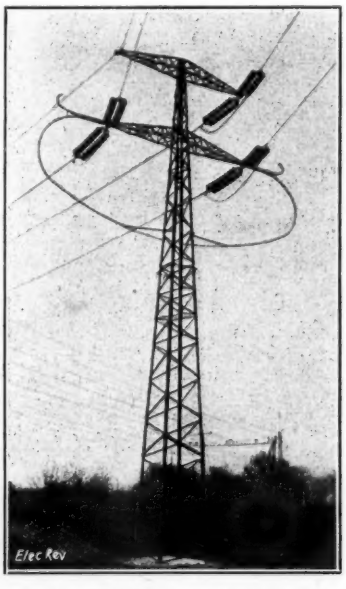


Fig. 6.—150,000-V Anchoring Mast.

the water power of the Rivers Pau and Cauterets, consists of three 3,500-h.p. Pelton-wheel turbines and generators, running at 333 r.p.m., and three sets with Francis turbines running at 500 r.p.m.; each group of three sets is served by a 350-h.p. turbo-driven exciter. The main three-phase, 50-cycle energy is generated at 10,500 volts and stepped up to 60,000 volts for transmission by means of two lines which supply a sub-station at Lourdes. The Eget power station is equipped with seven horizontal 5,000-h.p. Pelton-wheel turbines and generators, 500 r.p.m., and two groups developing 450 h.p. each at 900 r.p.m. for auxiliary purposes. The main supply at this station is also stepped up to 60,000 V and partly delivered to a sub-station at Arreau and partly to a step-up (150,000-V) station at Lannemezan.

The three power stations in the Ossau valley are located at different altitudes, the two lower ones utilising the water from the discharge canal of the uppermost station. At the lowest station, the Houbat, where a net head of 669 feet is available, the main plant includes five 10,000-h.p. Francis turbines running at 500 r.p.m., each coupled to an 8,000-kVA alternator generating at 10,000 volts. Except that the turbines are of the Pelton-wheel type, the plant at the midway station, the Miegebat, which works under a head of 1,246 ft., is similar to that of the Houbat station. The uppermost station, the Artouste, at present in course of construction, has a net head of 2,446 feet. The main plant will include three 500-r.p.m., 10,000-h.p. Pelton-wheel turbines, each coupled to an 8,000-kVA generator. The three stations will be so grouped as to be able to produce continuously 28,000 h.p., and at certain periods of the year a maximum of 60,000 h.p. The three power stations and the 60,000/150,000-V transformer plant adjoining the Houbat station are interconnected by 60,000-V lines. All the turbines for the three power stations in the Ossau valley were constructed by the Société des Constructions Electriques de France, which concern also supplied the electrical equipment for the Houbat and Miegebat stations; the electrical equipment for the Artouste station is being furnished by the Compagnie Française Thomson-Houston. The transformers at all three stations were constructed by the Société des Forges et Ateliers de Constructions Electriques de Jeumont.

In order to provide the necessary power as the work of electrification proceeds, the Midi Co. contemplates the establishment of a series of power stations in the Upper Ariège and Tet valleys on similar lines to those in the Ossau valley already alluded to. The Ariège group will give a continuous output of 40,000 kW, and the Tet group an aggregate of 20,000 kW.

The 60,000/150,000-V transformer stations are located at Houbat, for the Ossau valley supply and Lannemezan, for the power from the Eget station. The current from the Soulom station is distributed directly to the 60,000-V system. Later on a new transformer station will be established at Ax-les-Thermes to deal with the power from the Ariège group of stations.

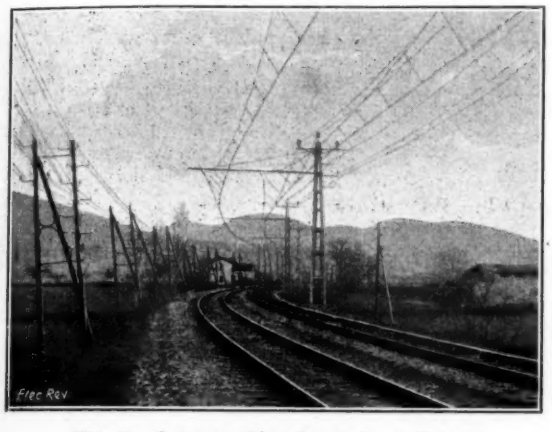


Fig. 7.—Catenary Line Supports on Curves.

The 150,000/60,000-V sub-stations are located at Dax, fig. 2, Pessac, near Bordeaux, Portet-Saint-Simon, near Toulouse, and at Tournay. Fig. 1 shows the equipment on the 60-kV side of the last-mentioned sub-station. A further step-down station is later to be established at Pinet, near Millau, on the Tarn.

In all the step-up stations the transformers and main switchgear are in the open, while in each case a large building accommodates the switch-control panels, synchronous compensators—where these are used—and a large repair shop with transformer-drying and oil-purifying equipment. Each station, on both the 60,000- and 150,000-V sides, is provided with two sets of bus-bars so arranged that they can be coupled together.

On the 150,000-V side no protective equipment for over-pressure is provided for the lines, and corona effect is relied on in this connection. On the 60,000-V side, however, self-inductance coils and condensers are installed for this purpose. The bus-bars and all the connections consist of steel tubes suspended from the roof by means of insulator chains. The 150,000-volt transformers and the Westinghouse-type compensators were supplied by the Compagnie Electro-Mecanique, of Paris, while all the 150,000- and 60,000-V apparatus, including portable-type mechanically controlled cut-outs and sectionisers were furnished by the Société des Ateliers de Constructions de Delle. The step-down stations are equipped with synchronous motors for power-factor correction, and the automatic adjustment of the excitation of these provides the necessary voltage regulation. These machines are fed at 6,600 volts from a third winding on the main transformers. The 150,000-V sides of the transformers are protected by a system of maximum return-current and differential relays.

The 150,000-V transmission system includes two lines, carried on independent bracket supports, starting from the Houbat station and ending at a sectionising station at Jurancon, near Pau. From the latter there extends two lines, also on independent brackets, to feed the Dax station, which, after passing *via* the sectionising station at Labouheyre, terminate at the Pessac station. A third 150,000-V line also runs from the Pau station, *via* Lannemezan to that at Portet-Saint Simon, and a further line is being erected between the Portet-Saint Simon and Pinet stations, and two others are to be erected later between the Ax-les-Thermes and Portet-Saint Simon stations.

The lines are anchored at every 2½ miles, standard types of straight-line and alignment-anchoring masts having been adopted for the whole of the system (figs. 5 and 6). For 143-sq. mm. copper conductors the masts are spaced at intervals of 219 yards, while the masts carrying 188-sq. mm. aluminium-steel lines are spaced 268 yards apart. The conductors are suspended from the masts by chains of insulators, each comprising nine aligning and eleven anchoring elements. To reduce inductance effects the three conductors are completely turned once in each three spans.

Generally speaking, only single transmission lines are used on the 60,000-V system, but double lines are employed for connecting the transformer stations together, or with the remainder of the distribution system. Either 100-sq. mm. copper cables, or aluminium cables of 172-, 95-, or 83-sq. mm. section are used. They are supported by means of insulator chains consisting of three elements on the straight sections and four elements at turns and anchoring points, rigid insulators being in some cases used for the latter work. The lines are supported either on the contact overhead-line supporting columns, or on independent masts, and are turned once in every 2-mile length.

The conversion of the 60,000-V a.c. to 1,500 V d.c. is dealt with in the traction sub-stations, after transformation, by means of rotary convertors or mercury rectifying apparatus. Fig. 3 shows exposed one of the 60,000-V/2 × 560-V, 3-phase transformers used in this connection. With the exception of the "subs" equipped with mercury rectifiers, they are all of the semi-outdoor type, with only the switchboards and small apparatus located in small adjacent buildings. In some cases the 1,500-V d.c. is supplied by single machines, and in others by two 750-V convertors in series on the d.c. side. Fig. 4 is a view of the interior of the machine room of one of the traction "subs," showing one of the 750-V machines.

The mercury rectifying sets, which were supplied by the Compagnie Electro-Mecanique, each consists of a transformer with double two-phase windings feeding two parallel-connected six-anode rectifying bulbs. Each set is capable of supplying continuously 1,200 kW at 1,575 volts. The bulbs are water cooled, but provision is made for the automatic operation of the circuit breaker, should the temperature of any one increase unduly. A rotary oil pump and a static mercury pump maintain the necessary vacuum in the bulbs.

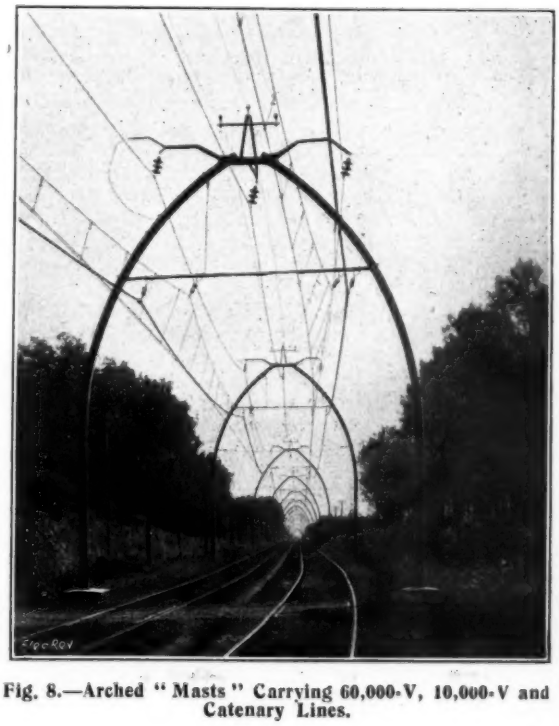


Fig. 8.—Arched "Masts" Carrying 60,000-V, 10,000-V and Catenary Lines.

The 1,500-V d.c. is supplied to the electric locomotives entirely by overhead lines of the inclined catenary type. The lines consist of a tarred galvanised-steel carry-

ing cable of 19 strands of 2.3 mm. diameter. Rigid supports of flat iron, 25 mm. wide by 5 mm. thick, are fixed at every 9 metres on the straight sections and every 4½ metres on curves. The supports, which are free to slide on the carrying cable, hold a slotted hard-copper wire of 100 sq. mm. cross section, known as the auxiliary carrier, from which is suspended a second and similar working wire by means of two clips between each pair of supports on the straight sections. Flexible "anti-balancing" devices are used to maintain the alignment of the working cable above the centre of the railway track. On the curves the intermediary supporting clips are not used, the ends of the main supports being provided with special clips which support the auxiliary carrying cable and the working cable on cylinders. Moreover, no anti-balancers are there used, the tension of the cables causing the supports to assume an inclined position, as shown in fig. 7. The angle of inclination of the supports varies with the temperature, and thus the latter brings about a variation in the tension of the working cable, with the result that within certain limits, when the straights and curves alternate regularly, the line automatically adjusts itself to temperature variations. This form of catenary is stated to result in considerable flexibility on the curves. As the trolley arm passes along it the line is lifted, taking with it the supports, at the same time reducing the tension on the working cable. The normal height of the working cable above the rail track is 6 metres. The masts are spaced at regular distances of 90 metres on the straight sections, and on slight curves and at shorter intervals on more acute bends in the line. The supporting masts vary in form according to the different track conditions. They consist of either metallic trellis-work columns, ferro-concrete posts (fig. 7), or arches built of wide-flanged joists (fig. 8). The arches carry also the 10,000-V and 60,000-V lines.

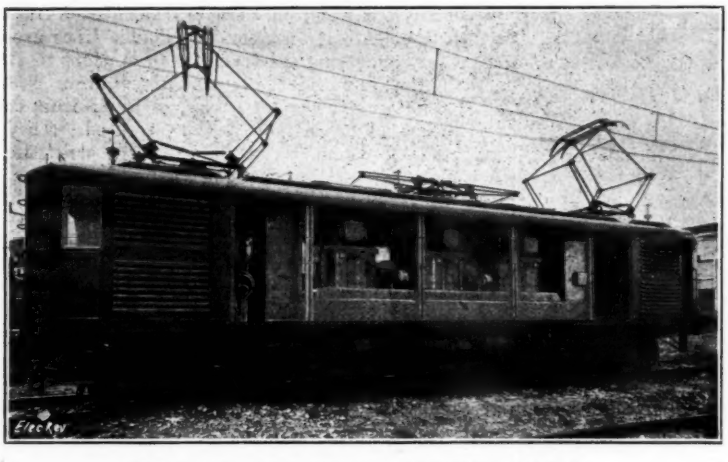


Fig. 9.—Type 2C2 Express Locomotive, 2,100 h.p.

The rolling stock includes four-axle double-bogie electric locomotives of the B.B. type, for the haulage of ordinary passenger and goods trains, and, for express trains, 2C2 twelve-wheel locos, with three intermediary axles and four-wheel bogies at each end. Electric motor coaches are used for local trains. The B.B. locos are capable of developing 1,000 h.p. continuously. The passenger trains are fitted with electric regenerative braking, while the goods locomotives have rheostatic electric brakes controlled by varying the field of the motors.

The B.B. locos. are equipped with four 1,500-V, 250-h.p. motors, each being connected to its corresponding axle through two sets of gearing.

Series-parallel control of the motors is effected by two camshafts which operate the different contacts. Each shaft controls two motors, so that one locomotive practically consists of two half engines each working independently of the other. The 120-V current necessary for the operation of the cam shafts and to supply the compressor is supplied by a motor-generator set. Each passenger loco. has a second variable-voltage generator which effects the excitation of the motor during the braking period. On the goods locos. the motor-generator set is provided at each end with a fan which supplies air for the cooling of the motors of the corresponding loco. sections. The equipment is protected against internal short-circuits by quick-operating devices, which insert a resistance in the main circuit and a circuit-breaker. Each 2C2 loco., fig. 9, is equipped with three motors, one for each of the central axles; they are of the vertical-shaft, completely-suspended type. Within the motor casing are two separate armatures mounted side by side and rotating in opposite directions, each driving through bevel gearing a hollow shaft supported entirely on the loco. chassis. The connection between the hollow driving shaft and the corresponding engine wheel is effected by special flexible couplings, fig. 10. It is claimed that the utilisation of two armatures per motor obviates the need for using thrust bearings on the hollow shaft, and that owing to the armatures rotating in opposite directions, all gyroscopic effect is overcome. The three electric motors are each capable of developing 700 h.p. for one hour or 500 h.p. continuously, both with full field or maximum shunt, a total of, respectively, 2,100 and 1,500 h.p. The three armatures are arranged in series, and so supplied each with current at 500 V. The control equipment of the 2C2 locos. is of the same type as that used in the B.B. locos. On maximum-shunt a speed of 87.5 m.p.h. has been attained on a 350-ton train. The cooling of the motors is provided by two 1,500-V motor-driven fans. On the 2C2 locos. Westinghouse automatic and also moderating brakes are employed.

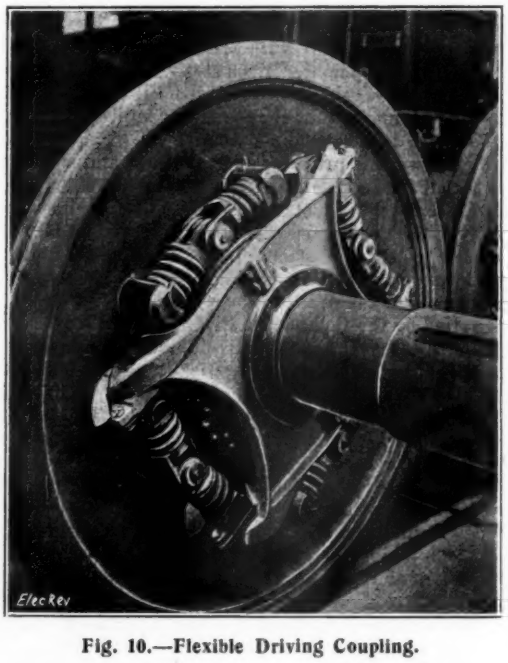


Fig. 10.—Flexible Driving Coupling.

In order to attain even higher average speeds, or to haul heavier trains than the 2C2 type, the Société de Constructions Electriques de France has also designed a 16-wheel locomotive known as the 2D2, which will have, in addition to two four-wheel bogies, eight wheels driven by four 800-h.p. motors. The line-contact equipment on each loco. and motor coach is kept raised by springs and lowered by means of compressed air.

The Maintenance of Motors, Starters and Controllers.

In the following article the authors deal in a practical way with means and methods for the prevention of and remedy for troubles commonly met with in the installation and running of electric motors and control equipment.

By E. DAINE DAWSON, Graduate I.E.E., A.M.I.Mech.E., and JAN. KUKA, A.M.Am.I.E.E.

(*Concluded from page 634.*)

A.C. induction motors being inherently simple, a considerable percentage of their troubles may be traced to causes aside from the motor, *e.g.*, faults in the current supply, errors in application, and so on. Troubles may also arise from defective mechanical construction, such as weak shafts, short bearings, unbalanced rotors, ineffective lubrication, and indifferent methods of securing and insulating the windings, or those due to defects in the starting and control gear.

The performance of an induction motor may be materially affected by a change in the voltage at its terminals. Both the starting torque and the maximum pull-out torque vary as the square of the impressed voltage. If the voltage is 20 per cent. low, the maximum torque will be about two-thirds the normal value. With a varying load, this reduction may be sufficient to render the motor incapable of handling the peaks. Low voltage may arise either from excessive line drops or trouble at the source of supply, which would mean that heavy currents would be carried. The transmission line installed should be of sufficient carrying capacity with low enough resistance, but the reactance of the line should be first considered. Reactance becomes a very appreciable factor when large currents are involved. In the case of low transmission voltage, the reactance becomes more than twice the resistance of the line, the result being low voltage at the motors and frequent stalling.

Squirrel-cage induction motors are commonly started with reduced primary voltage. If this voltage is secured through the use of auto-transformers, a number of taps are generally provided, rendering it possible to select a suitable starting voltage sufficient to produce the desired motor-starting torque. If middle-voltage taps of the supply transformers are used to provide reduced starting voltage, it is evident that only one-quarter full-voltage starting torque is available. This arrangement may not be feasible where heavy starting duty is to be met with. The star-delta starting scheme involves the application of 13 per cent. of running voltage across the windings at starting. The torque is obtained at about half the full voltage, and is ordinarily sufficient, but occasionally deficient.

Over-voltage is a much less frequent offender than under-voltage. Most motors will successfully withstand 10 per cent. over-voltage without serious results. The magnetising current is increased, lowering the power factor and increasing the iron losses, thereby raising the temperature of the machine and at the same time increasing the pull-out torque. Over-voltage is more frequently caused by incorrect windings.

Unbalanced voltage on the supply system is not an infrequent condition. The use of transformers of differing ratios in a bank, an imperfect Scott connection or unbalancing through single-phase lighting or welding load, may cause this occurrence. A three-phase induction motor may be conceived as three single-phase transformers having a common secondary. With this conception it is evident that an unbalanced primary voltage will result in unbalanced load, and in circulating currents which tend to equalise the primary voltage. In fact, induction motors running light might actually be used to equalise the voltages on unbalanced lines. The result of circulating currents in the ordinary case is overheating of the motor. If the unbalancing is at all severe, the motor may heat up, even without load; if not severe, heating above normal may be traceable to this condition.

Sometimes a two-phase or a three-phase motor may be accidentally caused to operate as single-phase. Such a condition may arise through the " blowing " of one of the phase supply fuses, or a faulty contact in one lead on the running side of the starting switch or compensator, the starting side being in good condition. A polyphase induction motor will not start single phase, but once running, it will continue to run and maintain its speed, but will operate at an abnormal temperature and take greater current from the remaining lines. The single-phase capacity of the motor is about 60 per cent. of that on polyphase working. If the load exceeds this amount, the motor will probably blow the remaining fuses and come to a standstill, or, if these be too liberal, it may overheat and damage the insulation, or even stall and burn out.

Conditions in the supply system leading to motor trouble may be readily detected by the voltmeter or ammeter. A voltmeter placed across the phases successively will indicate either single-phase or unbalanced voltage conditions. An ammeter in the supply leads will read unequal in cases of unbalanced voltage, but faults within the motor may also give this indication, so that it is not conclusive.

Overloading is one of the most common causes of induction-motor trouble. The pull-out torque or the ordinary induction motor is much higher than the load which it can continuously sustain. There is no commutator to indicate by sparking that the load is excessive, and the temperature is the only indication. It is not, therefore, an infrequent occurrence for an induction motor to carry an excessive load unnoticed while the insulation becomes charred or the rotor connections loosened. Overload is commonly a fault in application, too small a motor being selected or too much load applied or added. Frequently, however, an unusually heavy load is thrown on a motor by reason of some change in the adjustment or operation of the driven machine. Comparatively few machines perform a fixed duty without variation from any cause. Induction motors will handle overloads of short duration with ease, but continuous overloading must be watched for and avoided. An occasional recording-ammeter test is a good method of preventing trouble.

With wound-rotor motors it is possible for trouble in the secondary circuit to occur outside of the motor. The resistance of the rotor circuit of an induction motor does not, within moderate limits, affect the maximum torque of the motor, and it does not determine the speed at which maximum torque is exerted. Low resistance in the rotor circuit causes maximum torque to be exerted at nearly synchronous speed, the standstill or starting torque being much less than the pull-out torque. It is thus evident that if an attempt be made to start a motor of this type under load, with the external resistance short-circuited, comparatively little starting torque is available, and the motor may be unable to pick up.

As already stated, low resistance in the rotor circuit

causes the maximum torque to be exerted at nearly synchronous speed. A higher rotor resistance causes the maximum torque to occur at a lower speed and the starting torque to increase. At a given rotor-circuit resistance the maximum torque occurs at standstill; the torque diminishes at increasing speeds. If the rotor resistance be still further increased, the maximum torque will be actually decreased, although still occurring at standstill. It should thus be evident that any cause of high resistance in the rotor circuit, such as poor joints or contacts, or broken grids, will cause the motor speed to drop under load, and if sufficiently high, will cut down the b.h.p. of the motor and prevent its coming up to speed or starting under load at all.

The secondary circuit of a wound-rotor motor is practically always wound three-phase, and the external resistors are commonly star-connected. The breakage of a grid will open a phase and leave the secondary circuit single-phase. With one phase of the rotor circuit open, the motor has little starting torque and a decided tendency to remain at half synchronous speed, particularly if accelerating under load. With the motor running, the current in the primary lines will be practically balanced. With the rotor held fixed, the primary current will be unbalanced to an extent depending upon the exact rotor position. If all the phases in the secondary circuit of a wound-rotor motor are open-circuited, the motor will have no torque and will not start. The primary current will be only that required to set up the flux in the core.

Weak shafts and unbalanced rotors cause "whipping," and the rotor strikes against the stator cores. The rotor may be perfectly balanced mechanically, but the motor shows symptoms of out of balance if the rotor is not perfectly central in the stator casing, or if the stator and rotor-phase windings are not electrically balanced. Mechanical out-of-balance is indicated by the bumping or vibration being greater at certain critical speeds as the motor runs up. The cure is to put the rotor on a knife edge, locate the heavy side, and lighten it by drilling holes where practicable. If the rotor is out of centre, it is necessary, of course, to attend to the bearings. The amount of eccentricity can be judged by threading a thin steel wire or tape through the air-gap between the rotor and stator and testing for clearance at all points round the circumference. The air-gaps of squirrel-cage motors are very small, and it has happened, with a new motor overloaded for the first time, that varnish has run down into the gap and set hard when the motor cooled down, securely fixing the rotor to the stator. To remedy this, sufficient current should be put on the motor to heat it up till the varnish softens, withdraw the rotor, and remove all traces of the varnish.

Electrical out-of-balance is not easy to rectify, depending as it does on the design of the motor, and the makers should be informed.

Apparent out-of-balance may be caused by loose or broken connections in the stator or rotor, or on the starter, breaker or brush-lifting gear. A two- or three-phase motor will continue to run against load if one of the stator phases is broken, taking a considerably increased current from the other phases and thereby excessively heating the motor and making a peculiar noise whilst running, but it refuses to re-start after switching it off.

We come now to d.c. motor and control gear. All that has been written with reference to a.c. gear is of general application to d.c. apparatus, and there is no need to make more than a few brief observations on special features.

D.c. circuits are more difficult to interrupt than a.c. ones, and gear which would be quite adequate on a.c. will not necessarily do for d.c.; the inductive pressure rises are very much greater, and the arcing more vicious. As a rough guide it may be said that a breaker which will successfully interrupt 1,000 amperes on a.c. will only break 100 amperes on d.c. For this reason magnetic blow-outs are fitted on the larger sizes of d.c. breakers, and greater attention must be paid to the sparking tips and clearances above the arc. The latter point is important, and on high-capacity circuits there should be no apparatus mounted above the breakers, as flames about two to four feet high are not unusual with "dead shorts" on heavy plant.

Oil-breakers are used on d.c. circuits, but they are not to be recommended except for small currents. The oil has to be examined frequently for signs of sludging and carbonisation, and care has to be exercised to see that only the best quality of non-sludging oil is used. Air-breakers are now-a-days more advantageously used than oil-breakers for d.c., the reason being that with d.c. the current remains at a constant value, whereas, with a.c., the current, of course, passes through the zero point twice every period. The d.c. arc is therefore much more persistent and tends to consume and carbonise the oil as quickly as it tries to force its way between the separating contacts. The rapid carbonisation of the oil tends still further to maintain the arc, as does also the metallic vapours formed from the arc tips. In case of d.c. also the oil tries to force its way between the separating contacts and effectually does so at the zero point of the current, as theoretically the arc vanishes or dies away at each zero point. If the arc is not quenched after the first zero point, it follows that it will be after three or four zero points have been passed, since it is more difficult for the arc to reform itself as the arc tips get further and further away, and more and more oil is interposed between them.

D.c. oil switches have been used for small currents, but generally speaking they are not to be recommended except for special purposes where air breakers cannot advantageously be used. Hence, it is quite clear that the employment of an air-circuit breaker is a much safer proposition as regards the immunity from wear or breakdown when working than that of the d.c. oil-circuit breaker.

The main points of difference are the increased provisions for sparking and wear, and the different methods of connection to obtain various forms of control, such as diverter control to obtain slow speeds, irrespective of load and rheostatic breaking.

The former is mentioned here because diverter controllers should always be used when slow speeds are required, as for setting printing presses, or when there is no other way of getting belts on without the help of the starter.

The inherent speed regulation of a series motor is very useful, because it automatically gives high speeds at light loads and low speeds at heavy loads; but one may have too much of a good thing, and on very light loads the motor may run at three and a half times the normal full-load speed. This is readily modified by a special controller and a diverter resistance across the armature. Excessive speeds may be obtained when the load drives the motor, as when lowering a load on a crane, because the series motor does not brake naturally like a shunt motor. Braking can be obtained up to full load, and up to about 30 or 40 per cent. speed with special diverter controllers, but the braking effect vanishes after about 50 per cent. speed. Braking can be obtained at all loads and speeds on rheostatic braking controllers, but a sudden drop of the load is apt to occur when starting to lower full load, because the field has not had time to build up. These troubles may be avoided by special speed limiting shunt windings on the motors, or by special controllers designed expressly to limit the maximum hoisting speeds and provide effective control of the load on lowering.

Volumes could be written about the special application of the different types of starters and controllers, and the behaviour and characteristics of different types of motors, but as these notes are limited to "kinks" that have been disregarded.

Before bringing the subject to a close the authors venture to give in simple words the general instructions to keep everything quite clean, bearings well lubricated, all connections well secured, brushes well bedded, air-gaps well adjusted, and the plant well guarded against moisture.

Service in Theory and Practice.

Criticisms and Suggestions.

(Communicated.)

THERE are few terms which are more misunderstood or more misused than the word "Service." Though it may be broadly defined as "The performance of labour or offices for another," an average dictionary will give more than a dozen alternative meanings to the term. There would appear to be a similar diversity both of use and of meaning in its commercial applications, as although it is liberally quoted by suppliers it is often difficult to ascertain what is the precise significance attached to it. To judge from a careful perusal of a number of examples of which it is the central theme, in one case it may mean that delivery of goods is effected by the supplier's own motor vehicles; a factor stresses it, meaning that he keeps in stock the products of a large number of manufacturers; another advertiser uses it with the meaning that when a certain apparatus is supplied it will be started up free of charge. The last begins to approach the modern understanding of the term. It would not be unfair to state that the average customer regards it as meaning something for nothing, whether the something be repairs, adjustments, inspection, or advice. To electricity supply men service has a special meaning of its own.

Its Growth.

Twenty years ago a manufacturer of engineering plant of any description would probably have a separate repair shop, a separate order book for entering the orders for spares, and a man in charge. Under the influence of new management and new ideas, this probably becomes the "Service Department." There is, however, a subtle distinction which may be remarked in the average buyer's mind; for a repair or a spare part he expected to pay, but for the provision of "service" he does not. It is noteworthy that it is mainly the engineering and highly specialised trades which have been obsessed by the introduction of the word and all that it implies. The purchaser of footwear, for instance, has not yet been educated to the point of expecting to have it repaired free of charge after a period of wear, but this is a state of things which might be paralleled almost daily in the engineering and other highly specialised industries. No one who has had experience behind the scenes can fail to realise the effects upon profits and finance when the service ideal and service demands are allowed to get out of hand.

Its Cause.

It is to be feared that unreasoning and unreasonable expectations of service for nothing, must often be attributed to the manufacturers and suppliers in any industry where it has taken firm hold. "Service" (implying *free* service) is a theme round which it is an easy matter to allow the fancy to play both in advertising and in general selling negotiations. Other sales arguments and their adequate presentation may involve considerable thought, but a reference to service, on the lines of "Behind each article sold are marshalled the immense resources and the technical skill of the largest establishment of its kind in the world" or "Go to the house which gives you unquestioning service as well as sales"—here is a theme round which a copy-writer may allow his fancy to play at will. To judge from examination of examples, the only stipulation is that no precise details shall be given, for it is seldom that the offer is put into plain words. The inference drawn by the purchaser, however, is perfectly plain; it is that he can count upon getting something for nothing; that if trouble, wear, or accident should occur, he can count upon securing a great deal of work free of charge.

Service or Charity.

The result of this kind of service appeal is apt to have a nasty recoil. It may make a customer, but it is apt to make an unreasonable customer, who is firmly convinced that it is not his place to make any particular effort to understand or to take due care of his purchase, and that behind it stand the resources of a manufacturer to whom satisfaction of the customer is all in all. With the state of mind thus created, the most moderate of charges for work done after sale are apt to be regarded as an attempt at extortion to be resisted and disputed at all costs. Nor is this attitude entirely confined to the buyer. It is apt to have a subtle effect upon the mentality of the supplier's *personnel*, and a staff (especially those who are not in touch with the exact financial position) will often readily develop the idea that the concession of something for nothing (in other words, free service) cannot fail to be followed in some inexplicable way at some indefinite date by a large influx of profitable business.

Service and Selling.

In those rare cases where the service to be rendered is specified and explained, it may often be recognised as an example of price-cutting under another name; such an instance would be the free charging of accumulators when first sold. Other cases lie on the border-line, such as the plan to pay the expenses of a number of prospective customers to a London exhibition to inspect some new development, on the understanding that an order is placed within one month from the date of the trip. Other examples prove nothing beyond a disposition to waste money, such as the salesman who will stress with pride that his house can always be relied upon to deliver an article costing £20 a distance of nearly a hundred miles by road in their own van without extra charge if it should be required in a hurry—in other words, if the placing of the order has been neglected until it is almost too late! One of the best methods of keeping the service ideal within reasonable bounds is to see that every job which comes under this heading is carefully costed and the total of the service charges at the end of each year is compared with what has resulted therefrom.

A District Trader's Advantages.

When service in the shape of personal contact after sale is required, a local dealer is in a much better position than a manufacturer to make a point of it. Whether the article sold be an electric heater, a motor car, or any simple mechanical device, it is possible for him to maintain personal contact with the buyer with little expenditure in money or in time. Expert advice costs nothing to the skilled man, but it has immense value to the unitiated, and is usually thoroughly appreciated. A local dealer is therefore well entitled to make a point of this. The manufacturer with a *clientèle* spread over the whole of the kingdom cannot keep in personal touch in the same way, yet in many manufacturing quarters one may occasionally encounter the belief that because a big local trading concern with all its customers solidly located within a radius of five miles initiates some elaborate scheme of personal service or inspection, it is possible to imitate it. It is lack of appreciation that circumstances alter cases which makes for big losses. It has to be recognised that the average manufacturer is not well situated for personal calls, personal inspections, and adjustments on site, and if he is sometimes tempted to complain of the unreasonableness of buyers in expecting it, he should bear in mind that the habit of mind has been fostered by the lavish offers of unspecified service which are constantly made.

The remedy is to eliminate from the sales talk all vague promises and obscure references to service as something for nothing, and if the subject of after-sale service of any kind has to be referred to, for some precise indication to be given of what is intended. In this connection, it might be borne in mind that those things which are paid for are invariably appreciated in the long run more highly than those which are obtained for nothing.

Electricity Supply Service.

A branch of service work which has been much talked about on both sides of the Atlantic for some years past is that which is given by an up-to-date electricity supply undertaking. It is often said, and with truth, that a satisfied consumer is the best possible advertisement for electricity; satisfaction of many parts of a domestic installation can often only be obtained with the generous service assistance of the Maintenance Department, of the canvassing staff of both sexes, or of the electrical contractor who follows up his first work with solicitude for the customer's freedom from anxiety and annoyance. The writer can tell two stories of contiguous boroughs where to serve or not to serve is the question. In one borough the Electricity Department provides its consumers with a supply of pink postcards addressed to the Department, on which the consumer can state what has gone wrong. Such a card posted over-night is sorted out from the morning post by reason of its special colour, and it is handed over for emergency service and the consumer is greatly impressed by the expeditious manner in which the Department helps him or her out of a difficulty with the cooker, the lighting service, or whatever has been causing trouble. In the second borough you may ring up and find nobody there at certain awkward times, or if you are fortunate to get some member of the staff transferred from his other duties you will be highly favoured. Should a second consumer some distance away also be simultaneously in trouble and ring up for help, he cannot obtain it until the aforesaid non-maintenance official has returned to headquarters from the job that he ought not to be doing.

Practice varies in detail and certainly in efficiency in different parts of the country, but there is no room to question the wisdom of giving the consumer the best possible service that can be afforded.

Design and Behaviour of Magnetic Potentiometers.

The author deals with an interesting device. the possibilities of which are not generally known to engineers. Its field of usefulness is indicated, and the methods of design for any particular work are fully described.

By J. ERNEST SHAW, M.Sc., A.Inst.P.

Introduction.

THE advance of electrical science unfolding new designs of electrical apparatus and machinery offers an ever-widening field for more refined and novel methods of measuring electrical quantities. As a direct consequence of this, it frequently happens that methods of measurement already known but not generally used can be exploited with considerable success.

The device known as the "magnetic potentiometer," first described by Chattock*, affords a striking example of this statement, and it is considered that an article on this subject should prove valuable to engineers generally. The writer has found the possibilities of this instrument both extensive and unique in the course of general electrical measurements, and it is proposed to deal here at some length with the design and behaviour of the device and te indicate its sphere of usefulness, which includes the measurement of heavy currents in alternating-current networks that could not otherwise be easily measured, circulating currents in various parts of machinery, reluctance of magnetic joints, ampere-turns on any assigned part of a magnetic circuit, exploration of leakage fields, &c.

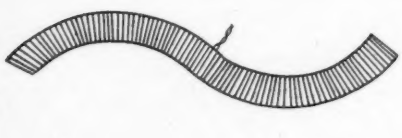


Fig. 1.

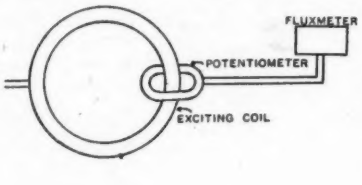


Fig. 2.

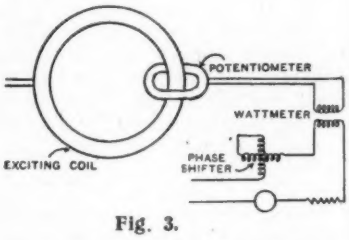


Fig. 3.

Theory.

The instrument in effect consists of a solenoid of constant cross-sectional area wound with a uniform number of turns per cm. on material having unit permeability (fig. 1).

Consider such a solenoid and let

T = turns per cm. length
A = cross-sectional area (cm.^{2})
l = length of the potentiometer in cm.

If this solenoid is placed in a magnetic field and the magnetic potential difference at its ends is changed by an amount θ, a voltage will be induced in the windings of the potentiometer.

Let θ = change in the average magnetic potential difference of the two free surfaces.

Then $\theta = \int H\, dl$

where H = change in the field strength at any point of the potentiometer

and $A\theta = \int \theta\, d_A = \iint H\, d_A \,.\, dl$

The e.m.f. induced in the potentiometer will be

$$e = d/dt \,.\, \iint H\, d_A \,.\, T\, dl$$
$$= d/dt \,.\, T \iint H\, d_A \,.\, dl$$
$$= AT\ d\theta/\delta t \qquad \text{.....(1)}$$

Equation (1) shows that for an instrument of laboratory dimensions and at commercial frequencies, the e.m.f. induced in the windings is proportional to the rate of change of magnetic potential at the two free surfaces, as the cross-sectional area and turns per cm. length are constant. This property enables the instrument to be used for the measurement of any change of magnetic potential at the ends of the device, provided some

* *Phil. Mag.*, 1887, xxiv, 98. Phys. Soc. *Proc.*, 1888, ix, 23.

convenient means are available of measuring the voltage induced in it.

The applications of the potentiometer on a.c. and d.c. circuits will now be discussed.*

Direct-current Measurements.

In the case of d.c. fields no e.m.f. will be induced in the potentiometer unless there is a change in the average magnetic potential difference of the two free surfaces. However, if the magnetic potential of these surfaces is made to change by drawing them out of a field, or bringing them into a field, a quantity of electricity will be induced in the potentiometer proportional to the number of lines of equipotential cut. This can be conveniently measured by a fluxmeter or ballistic galvanometer.

For the purpose of calibrating the instrument for use on direct-current circuits, the following method is the most convenient:—

The two ends of the winding of the instrument are connected to a fluxmeter or ballistic galvanometer, and the two plane surfaces forming the two ends of the potentiometer are brought into contact, enclosing in the loop so formed one limb of a coil of known turns through which a known current can be passed. The two surfaces will then be at the same magnetic potential, and this potential will change in exactly the same manner if the current is changed in the main exciting coil. By making or breaking the current in the main coil, an e.m.f. will be set up in the potentiometer which will cause a deflection on the fluxmeter (fig. 2).

The fluxmeter can therefore be calibrated to read in ampere-turns in conjunction with the potentiometer.

Great care must always be taken that the leads coming from the potentiometer are twisted, to avoid the possibility of extraneous e.m.f.'s being induced in the loops of these leads due to leakage fields; otherwise erroneous readings will be made.

Having the instrument calibrated to read in ampere-turns, it is a simple matter to find the ampere-turns at any assigned part of a magnetic circuit, as this can then be determined by placing the two surfaces of the potentiometer across the assigned portion of the circuit and noting the deflection on the detector or withdrawing the surfaces from these two points and recording the reading.

The ampere-turns across a pole, air-gap, or magnetic joint can therefore be quickly and accurately obtained.

Alternating-current Measurements.

For the purpose of exploring alternating-current fields, it is convenient to use a vacuo-junction† for the purpose of measuring the voltage induced in the magnetic potentiometer.

A vacuo-junction merely consists of a heater circuit to which a voltage is applied, and connected to this heater is a thermo-couple which may be connected to a suitable detector, such as a unipivot galvanometer or other sensitive instrument, which can be calibrated to read in millivolts across the heater circuit or milliamperes flowing through the heater circuit.

Such an instrument measures the r.m.s. value of the voltage, so referring to equation (1) we see that the voltage induced in the potentiometer in a field of frequency f is

$$\begin{aligned} e &= AT\, d\theta/dt \\ &= AT\, (\sqrt{2}\, H\, f_1 \div 1/4\, f) \times 10^{-8} \text{ volts} \\ &= AT\, 4f\, f_1\, H_{max} \times 10^{-8} \text{ volts} \qquad \ldots\ldots\ldots\ldots (2) \end{aligned}$$

where f_1 = form factor

H = field strength (r.m.s.).

Lines of equipotential may be found by keeping one surface in a fixed position and varying the position of the other surface until no deflection is observed on the recording instrument. In this manner a.c. fields can be explored easily and rapidly.

For the measurement of ampere-turns on a given part of a circuit, circulating currents, heavy currents in conductors, &c., the potentiometer becomes a valuable piece of laboratory or test-bed apparatus, as cases often occur in practice where, due to some unforeseen cause, large circulating currents are set up in various parts of machines which it would be impossible to measure by the usual methods. Also currents in the rotor of a squirrel-cage induction motor can be measured at standstill, which would otherwise be impossible, and calculations readily checked, &c.

For this purpose it is convenient to calibrate the magnetic potentiometer and vacuo-junction to read in ampere-turns, and then it may be used for all the a.c. measurements mentioned above. It will be appreciated that the field set up by a conductor carrying 1 amperes is similar to that set up by a conductor composed of N wires each carrying $1/N$ amperes; hence to calibrate the potentiometer for the measurement of large currents, one has only to obtain a coil of known turns through which a convenient accurately measurable current can be passed. Having obtained a suitable exciting coil with a known number of turns, the two plane surfaces forming the ends of the potentiometer are brought into contact, enclosing in the loop so formed one limb of the coil, similar to the procedure when calibrating with d.c.

The two ends of the potentiometer winding are then connected to the heater circuit of a vacuo-junction through a non-inductive resistance box, and a suitable unipivot galvanometer is connected to the galvanometer circuit of the vacuo-junction. Alternating current is then passed through the exciting coil at a given frequency, and the e.m.f. induced in the potentiometer is registered on the galvanometer. The arrangement can therefore be rapidly and accurately calibrated in ampere-turns.

The potentiometers should be calibrated on circuits having the same form factor as that on which they are going to be used, otherwise a correction would need to be introduced (*cf.* equation (2)).

The current flowing in any member of an electrical circuit can rapidly be obtained by enclosing it in the loop formed by bringing the two ends of the potentiometer into contact, and reading the deflection on the calibrated galvanometer.

This method gives the magnitude of the current or ampere-turns in a circuit, but cases may occur in practice when it is desirable to know both the magnitude and phase of the current to be measured, and for this purpose the following method may be conveniently used:—

First of all, for the purpose of calibration, the potentiometers are fixed in the usual manner around one limb of a coil having a known number of turns, as in fig. 3. The voltage induced in the potentiometer coil will lag by 90 electrical degrees behind the main current flowing in the limb of the exciting coil, and will be proportional to the current flowing in that limb.

The two ends of the magnetic potentiometer are connected to the pressure coil of a unipivot dynamometer-type wattmeter, the current coil of which is connected through a phase shifter to the source of supply.

The wattmeter can be calibrated to read in amperes flowing in the main circuit by supplying the current coil with a constant current, the phase of which can be altered by a phase shifter. For any given reading the phase of the current in the current coil is adjusted until a maximum deflection is obtained, making the reading proportional to the voltage induced in the potentiometer.

Having calibrated the potentiometers with the wattmeter as indicated above, the device may be used to find the magnitude and phase difference between any number of currents by fixing the potentiometers in position around the various limbs of the circuit and connecting to the wattmeter as shown in fig. 3. The phase shifter is adjusted in each case until a maximum deflection is obtained. The phase angle difference between two or more currents can then be obtained by noting the different readings on the phase shifter required to give a maximum reading on the wattmeter in each case.

It should be noted that when the magnetic potentiometer is used for the measurement of current, the circuit carrying the current need not be broken, as would

* J. E. Shaw—"Application of Magnetic Potentiometer," *Metropolitan-Vickers Gazette*, Oct., 1925.

† "Dictionary of Applied Physics," p. 646.

be required for inserting an ammeter or shunt. This offers distinct advantages in heavy-current work, as the insertion of an ammeter in a low-resistance circuit may alter the quantities one wishes to measure, whereas the alteration in current to be measured by the introduction of the magnetic potentiometer is quite negligible.

Design of Magnetic Potentiometer.

It is not proposed to deal here with the numerous applications of this device, but rather to indicate its wide field of usefulness, so we will now pass on to its general behaviour and design for any assigned work.

The cross-sectional shape of the potentiometer is immaterial provided that it is constant throughout its length, so a suitable shape may be chosen for any desired work. It should be pointed out here that it is desirable to make the cross-sectional area as large as conveniently possible, so that maximum sensitivity will be afforded.

It is often convenient to wind the potentiometer on solid rubber cord or rubber strip, but in special cases, where a definite shape is required, it may be wound on fuller-board or other material having unit permeability.

Having decided upon the cross-sectional area and shape, the next step is to decide upon the length of the potentiometer; 18 in. to 24 in. is usually a convenient length. If the instrument is to be used for direct-current measurements in conjunction with a fluxmeter or ballistic galvanometer, we may proceed to calculate the quantity of electricity induced in the potentiometer under given conditions as follows:—

Let $I\,N$ = ampere-turns to be measured.

Then on pulling the two surfaces of the potentiometer from position on the circuit we get the following relationships:—

$$\text{Instantaneous e.m.f.} = -T\,l\,4\pi \,.\, d(I\,N/l)\,A/dt \times 10^{-9}$$

$$\text{Instantaneous current } i = -Tl/R\;4\pi \,.\, d(I\,N/l)\,A/dt \times 10^{-9}$$

$$\text{Quantity of electricity } Q = \int i\,dt$$

$$= -A\,T/R \,.\, 4\pi\,I\,N \times 10^{-9} \text{ coulombs,}$$

where R = total resistance of the circuit.

From the above equation, the area, turns per cm., &c., can be chosen to give any desired sensitivity for measurements.

For use on alternating-current circuits in conjunction with a vacuo-junction, we may proceed with calculations as follows:—

For maximum sensitivity the resistance of the potentiometer should equal the resistance of the heater circuit of the vacuo-junction. Therefore if

r = resistance of heater of vacuo-junction,
l = length of potentiometer (cm.),
d = diameter of core (cm.), considering a circular core for simplicity,
d' = diameter of copper wire (cm.),
d'' = diameter of copper wire + insulation (cm.),
ρ = resistivity of copper,
0.90 = space factor, taken low on account of following approximations,

$$\text{then } (\rho\pi d \div \pi(d')^2/4) \times 0.90/d'' \times l = r$$

$$\text{or } 1/(d')^2 d'' = r/3.6\,l\,\rho\,d$$

$$\text{Approximate by making } d' = d'',$$

$$\text{then } d' = \sqrt[3]{(3.6\,l\,\rho\,d/r)}.$$

Take the nearest size of double-silk-covered wire, and the e.m.f. may then be estimated:

$$\text{e.m.f.} = 4f\,f_1.\;A\,T\;H_{max} \times 10^{-8} \text{ volts.}$$

Passing on to the performance of the instrument, an examination of the following four types will serve to indicate its behaviour.

Table 1.

	Diam. of rubber core.	Length.	Cross Sect. (cm.)²	Turns per cm.
No. 1 potentiometer	... ½ in.	15 in.	0.71,	45
No. 2 potentiometer	... 9/16 in.	15 in.	1.57,	53
No. 3 potentiometer	... ½ in.	18 in.	1.2,	45
No. 4 potentiometer	... ½ in.	24 in.	1.2,	45

In calculating the e.m.f., allowance should always be made for a shrinkage in the diameter of the potentiometer if a rubber core is used, due to winding under tension. This varies with different individuals and with the type of rubber used, but generally 2-3 per cent. is sufficient for practical purposes.

The performance of the instruments was first examined on d.c., and the results obtained on calibration agreed remarkably well with the calculated figures as will be seen from Table 2.

Table 2.

Potentiometer No.	Calculated quantity for circuit of given resistance.	Observed quantity.
1 ...	0.3, μc ...	0.3, μc
2 ...	0.8, μc ...	0.8, μc
3 ...	0.6, μc ...	0.6, μc
4 ...	0.5, μc ...	0.6, μc

μc = microcoulombs.

It is always advisable to calibrate the potentiometers before making any measurements with the particular instrument they are to be used with, as considerable errors may occur in calculating for a given circuit if the cross-sectional area and turns per cm. are not uniform. However, the above table indicates the order of the accuracy to which calculations on d.c. can be made when the potentiometers are wound with reasonable care.

The performance of the instruments was examined at power frequencies with the same gratifying results. The curves of open-circuit e.m.f. at 50 cycles against ampere-turns were straight lines. Table 3 gives a comparison between calculated and observed readings.

Table 3.

Potentiometer.	Calculated e.m.f. (volts).	Observed e.m.f. (volts).
No. 1 ...	0.45, ...	0.44,
No. 2 ...	1.29, ...	1.2,
No. 3 ...	0.89, ...	0.88,
No. 4 ...	0.89, ...	0.88,

at 4,000 ampere-turns, 50 cycles.

The calibration of the potentiometers remains constant over a considerable period of time and, provided the necessary correction is made for temperature, need only be checked periodically.

These devices can be easily and rapidly wound for any desired sensitivity. After winding it is preferable to wind back spirally a couple or more turns to the centre of the solenoid from each end, before soldering leads to the device; this eliminates a loop conductor running from each end of the potentiometer to the centre of the winding, which is liable to cause errors.

This additional spiral should be uniformly spaced, and should never exceed five turns. These additional turns need not be taken into consideration in calculations, as they will partly compensate for shrinkage in diameter, &c., when winding.

In conclusion, it should be mentioned that the sphere of usefulness of the instrument is not limited to d.c. and power frequency measurements alone, as it has been used for the measurement of high-frequency currents with considerable success.

The author desires to express his thanks to the Admiralty for permission to publish this article.

Very-High-Pressure Steam Plant.

According to the *Electrical World*, steam will be generated at 1,350 lb. per sq. in. in the new Deepwater (N.J.) station, which is jointly owned by the American Gas & Electric Company and the United Gas Improvement Company, and for which Messrs. Babcock and Wilcox, Ltd., have supplied four standard and two reheat boilers for operating at the above pressure. The standard boilers with a steaming economiser and air preheater will produce 331,000 lb. of steam per hour at 725 deg. F., and the reheat boilers will deliver 290,000 lb. of steam per hour and reheat 419,000 lb. of steam to 775 deg. F. The initial capacity of the generating plant of the station will be 118,500 kW, and the steam operating pressure for the turbines will be 1,200 lb.

Southern Railway Electrification.

Some of the great advantages secured and improvements effected as a result of the conversion of the 256 route miles now being, or shortly to be, operated electrically around London.

By E. C. COX, C.B.E., M.V.O., M.Inst.T.

(Extracts from paper read before the INSTITUTE OF TRANSPORT.*)*

ELECTRIC working on what is now the Southern Railway commenced nearly thirty years ago when the underground Waterloo and City Railway, consisting of two tracks each about 1¼ miles long in separate tubes, was opened. The L.B. & S.C. Railway Co. commenced electric traction in 1909, and the L. & S.W. Railway Co. in 1915, with very satisfactory results.

After the Southern Railway Co. came into being as a result of the Railways Act, 1921, one of the first problems to receive attention was the unification and standardisation of the electrification legacies it received from its constituent companies; the position may be summarised as follows:—

South Western Section:—Forty-nine route miles equipped on the direct-current third-rail 600-volt system at work, and extension representing about 30 additional route miles decided upon.

Brighton Section:—Twenty-four route miles equipped on the alternating-current (6,600-volt) overhead conductor system at work, and extension representing 17 route miles in preparation.

South Eastern Section:—Electrification of about 100 route miles decided upon, but not commenced.

The cost of the electrification already in being on the South Western and Brighton sections had been two and a quarter million pounds, and the work to be taken in hand, consisting of 67 track miles on the South Western section, 82 on the Brighton section, and 250 on the S.E. & C. section was to cost 5¼ million pounds, making a total of 647 track miles, covering 212¾ route miles to be completed early in 1926 at a cost of 7¾ million pounds.

The preparations which had been made before amalgamation for the a.c. system extensions were completed in 1925, and in the same year the d.c. extensions of the old South Western routes were opened. Concurrently the first portion of the South Eastern section electrification was inaugurated.

Other important work in connection with expediting train movements and increasing track capacity was the provision of colour light signalling of the four aspect type in certain sections, extensive rearrangement of permanent way and platforms, and reconstruction of stations, and large sums were expended on carriage sheds.

During 1927 some 13,135,810 electric train miles were run on the Southern Railway, and the car miles amounted to 69,708,345, an average of 5.3 car miles per train mile. Table I shows the incidence of this mileage and the cost of running it on the three sections:—

TABLE I.

	Western Inc. W. & C. Ry.	Central.	Eastern.
Train miles loaded and empty	5,433,323	2,354,796	5,347,691
Car miles	28,310,577	13,874,439	27,523,329
Average car miles per train mile ...	5.2	5.8	5.1
Cost of working and maintenance, *i.e.*, electric power permanent way conductor rail, electric train vehicles and guards	£347,118	£287,920	£433,190
Cost per train mile	15.33d.	29.34d.	19.44d.
Cost per car mile	2.94d.	4.98d.	3.78d.
kWh of electricity used for traction ...	57,921,291	37,083,336	63,170,706
kWh of electricity used per train mile	10.74	15.75	11.81
kWh of electricity used per car mile...	2.06	2.67	2.30
Cost of generation or purchase and distribution of electricity used for traction	£149,313	£126,133	£224,550
Ditto per train mile	6.65d.	12.86d.	10.08d.
Ditto per car mile	1.28d.	2.18d.	1.96d.

On the western section electricity is generated at the Railway Company's own power station at Wimbledon, and last year 69,317 tons of coal was consumed at a cost varying from about 34s. to 18s. per ton; had the prices which ruled for some months prior to the miners' strike been maintained during 1927, the cost of the coal used would have been about £10,000 less. Electricity for the eastern and central sections is purchased from the London Electric Supply Corporation's power station at Deptford. The consumption per car mile on the eastern section is 2.30 kWh, compared with 2.06 kWh on the western section, the former having more stations per mile, steeper gradients, and more tunnels.

During 1927, the total number of passenger journeys between all stations in the electrified area was 169,824,041 and the receipts therefrom £3,765,702. Table II shows the incidence of this traffic:—

TABLE II.

	Western section including W. & C. Railway	Central section.	Eastern section.
Passenger journeys	60,553,872	50,020,253	59,249,916
Receipts	£1,384,808	£1,010,088	£1,370,806
Receipts per journey	5.49d.	4.85d.	5.55d.
Receipts per train mile	61.17d.	102.95d.	61.52d.
Receipts per car mile	11.74d.	17.47d.	11.95d.

Excluding local bookings on the Waterloo & City Railway, the total number of passenger journeys between stations in the electrified area was 166,294,231, and the receipts therefrom £3,737,946, increases over 1924 of 4.631 per cent. in passenger journeys and 4.866 per cent. in receipts. The traffic for 1927 divided between the old Brighton and South Western electrified areas and the extended areas opened after amalgamation was as shown in Table III:—

TABLE III.

	Passenger journeys.	Receipts.
Old area	71,167,342	£1,312,207
Extended area	95,126,889	£2,425,739
Total	166,294,231	£3,737,946

The increase in the extended area, as compared with 1924 when it was steam operated, was 17.648 per cent. in passenger journeys and 15.951 per cent. in receipts; there was a considerable falling off of traffic in the old area, the increase on the total for the whole electrified area being only a little over 4¼ per cent., due to the loss of short-journey passengers, principally in the inner London area, chiefly owing to intensified road competition. There can be no doubt that, within a radius of three or four miles from Charing Cross, the circumstances favour road transport, and our experience of the change which has taken place in this respect during the past 25 years emphasises the necessity of the various transport organisations coming to an understanding as to the class of traffic for which they are respectively most suitable and for which they should cater. The proper course to pursue seems to be to perfect the road transport facilities between the City and West End and the districts within four miles thereof, and so arrange them that they link up at the edge of this radius with rail services to the districts farther out.

A census taken on a normal Friday in February last shows that, during the 24 hours, over half a million passengers were conveyed to and from our London terminal stations; of this number, nearly 29 per cent. arrived during the peak hour in the morning, and departed in the evening peak hour. The lines over which these numbers are carried radiate through a semi-circle immediately after leaving the Metropolis in districts which have largely become the dormitories and pleasure grounds of a very considerable part of the day population of London. Numbers of these daily travellers have their dormitories as far away as the Kent, Sussex and Hampshire coasts, which also are favourite playgrounds for London and the suburbs; consequently both long- and short-distance trains have to be dealt with during the peak periods. The altered conditions of labour generally have resulted in the concentration of the peak traffic within a shorter period of time, the movement Londonwards between 8.0 and 10.0 a.m. and outwards from 5.0 to 7.0 p.m. being much greater than it was before the war, with a corresponding reduction of early morning and late evening travel.

An admixture of steam and electric working in the suburban area prevents full capacity being reached, and it also became evident that, if the full advantages of unification under amalgamation were to be obtained, two different systems of electric traction could not be operated with economy. A decision was reached nearly two years ago to expend a further sum of 3¾ millions to complete the uniform equipment of the whole of the suburban lines. The scheme which is approaching completion, and a part of which was brought into use in April, 1928, comprises the whole of the old Brighton line suburban area with a small portion of the South Eastern and includes the equipment of 127 single track miles of existing a.c. overhead system with the direct-current third rail instead, together with the laying of a third rail over 105 single track miles of railway hitherto worked by steam, a total of 232 track miles altogether, exclusive of sidings, representing 83 route miles. For a time the overhead electric system will remain, and trains will be worked by this system concurrently with, and over the same track as, trains worked on the third-rail system. Ultimately, however, the overhead equipment will be eliminated, and all trains will be worked on the third-rail system, thus standardising for all three sections of the Southern Railway the suburban train equipment, track, &c.

When the equipment of these lines is finished early next year the total route miles of the Southern Railway electrified will be 255¼, embodying 875 track miles at a total cost of 11¼ millions. The services hitherto operated on these lines involve 2,038,556 steam and 2,377,973 overhead electric train miles per annum, or a total of 4,416,529 train miles. The proposed new all-electric services will give an annual train mileage of about 7¾ millions, equivalent to 100 per cent. increase in the case of present steam mileage, and 50 per cent. in the present electric mileage, also being a first step towards the allocation of trains from certain districts to one terminal station in London only.

It is hoped to reach the final stage of the scheme early in March, 1929.

The institution of electric services at regular and frequent intervals throughout the day in place of steam services running at irregular and infrequent intervals, renders it increasingly difficult to work heavy freight train traffic from North of the Thames to the South and *vice versa* through the crowded London area; its gradual compression into the night hours, when the passenger services are not running, has led to difficulties and delay, to surmount which it has been decided to expend about £270,000 on the construction of two new loop lines on which four-aspect colour-light signalling will be installed at a cost of about £80,000.

Many other important engineering works have been undertaken, including the widening and rearrangement of lines to provide for the running of new services of electric trains.

So far as the signalling arrangements are concerned, the retention of the existing mechanical system would involve a large expenditure to provide for the necessary alterations consequent upon the rearrangement of the lines: moreover, its perpetuation would undoubtedly involve future heavy expenses in renewals, maintenance, &c. At a cost of about £150,000 it is proposed to provide for the extension of 4-aspect light signalling and for the introduction of 3-aspect signals on certain other sections, resulting in a net saving of 35 signalmen, four signal lads, and five signal lampmen. This represents an economy of, approximately, £8,859 per annum, to which must be added £100 in respect of stores, &c., and £226 in signalling maintenance, making a total annual saving of approximately £9,176.

Having regard to the density of traffic in the London Bridge area, there is no doubt that we shall reap considerable advantage from the speeding up which will result from the introduction of light signalling. The new signal box at London Bridge will be one of the largest and most up-to-date of its kind in the world, containing 311 electrically-operated levers which will control the movements of about 2,500 trains a day, and will be brought into operation in June next.

On the completion of the scheme which came into operation in 1926 the d.c. electric train vehicles at work were as shown in Table IV:—

TABLE IV.

	Coaches.				Trains.	
	3rd class motor coaches.	Trailer composites.	Trailer thirds.	Total coaches.	3-coach units.	2-coach trailers.
Western section ...	220	110	74	404	110	37
Eastern section ...	268	134	134	536	134	67

Of this number only 87 vehicles in use on the eastern section were entirely of new construction, the remainder having been converted from steam stock which would otherwise have been redundant on the introduction of electric trains. In tiding over the transition period, it has been necessary to continue in service a number of vehicles which would otherwise have been broken up. This is the position at the present time in making provision for 116 three-coach motor units and 47 two-coach trailer sets, a total of 442 additional electric train vehicles required for the operation of the scheme which will be completed a year hence, as all of these will be found from converted steam stock.

I have every confidence that the results which will be obtained will ensure an adequate return on the huge expenditure of 11¼ millions. That our electrification policy is fully justified is, I think, confirmed by the fact that although the railways as a whole last year carried 71½ million fewer passengers than in 1925, the Southern Company conveyed between stations in its electrified area 7¼ million *more* passengers last year than in 1925. During January this year, the total number of passenger journeys between stations in the electrified area increased by 672,594, as compared with January last year. These results demonstrate that, notwithstanding severe competition and the loss of short-journey traffic in the inner London area, railway travel can be stimulated by improved facilities. Encouraged by such results as these, the prospect of extensions to more outlying areas in the near future is now receiving our earnest consideration.

Correspondence.

Correspondents should forward their communications as early as possible. No letter can be published unless we have the writer's name and address in our possession.

Closed Down.

I keep reading in the Review and daily papers of the big electricity schemes and the number of stations to be "closed down," and I wonder—and I feel sure I am not alone—what it means.

I allude to small stations, some with Special Orders and some without. Can you tell me how such stations have fared?

Interested.

April 10th, 1928.

Tapping the Single-phase Meter.

Referring to Mr. John G. H. Bowie's letter under the above heading in your issue of April 6th, there are no insurmountable difficulties in manufacturing a meter of the kind required. In fact, we have had in production for many years the Mordey-E.A.C. meter, the current coils of which are so arranged that two separate loads, charged at different rates, are registered on one set of dials.

We shall be pleased to send Mr. Bowie further particulars of the meter if he will communicate with us.

The Electrical Apparatus Co., Ltd.,
L. J. Matthews,
Chief Engineer, Meter Department.

London, *April 10th*, 1928.

Domestic Water Heating.

Your correspondents on the above subject appear to have overlooked the question of the prime cost of the apparatus. Most householders already have water-heating apparatus of some kind, and simply cannot afford to buy electric heating apparatus and to incur the further cost, probably, of extra wiring required. One of the main reasons why gas cooking and heating has expanded to so great an extent is that the gas companies supply the apparatus required on the hire, or hire-purchase, system, and when electricity supply authorities follow the far-sighted lead of the gas companies in this respect there will probably be an enormous increase in the demand for current for heating and cooking, but not before. First cost is a most serious consideration with the majority of possible consumers.

Seathorn.

April 14th, 1928.

[Our correspondent has hit the mark. Some progressive authorities have already adopted this plan, with excellent results, and there is no doubt that it is the only way to develop the domestic load quickly.—Eds. Elec. Rev.]

Battery Eliminators.

With reference to the letters by Messrs. W. Gard and M. G. Scroggie, published in your "Correspondence" columns on April 15th, the danger of using h.t. eliminators on d.c. mains to supply energy to radio receiving sets with directly connected telephones is very rightly stressed.

Your correspondents also point out that very few sets contain output transformers in the telephone circuit, and for this reason seem to condemn the idea of h.t. supply from d.c. mains. Now this is a pity, since the advantages of the mains unit over the battery methods are very well known. Therefore, the subject is worth discussion.

If manufacturers included an ordinary output transformer in their eliminators with the windings brought to four free terminals on the panel, and suitably marked, it would be a simple matter to run flexes from the output terminals of the set to the transformer and work the telephones or loud speaker from the terminals on the unit.

The engineer or retailer supplying the unit would quickly discover whether to include the transformer or not.

I fancy this, as a regulation, would be more welcome than the banning of a new branch of electrical engineering which has promised big things.

Leonard Bounds.

Ramsgate, *April 13th*, 1928.

[That battery eliminators on d.c. circuits will come into extended use is certain. As Mr. Bounds points out, it is better to remedy their deficiencies than to attempt to prevent their adoption.—Eds. Elec. Rev.]

The Smelting of Tin Ore.

I shall very much appreciate any information which your readers can give on electric furnaces suitable for the smelting of tin ore.

Information regarding the roasting of ore electrically (a process well known to those familiar with lode mines) will also be appreciated.

Consumer's Engineer.

Unfair Trading.

Please allow us to refer to the letter of Messrs. L. G. Hawkins & Co., Ltd., dated April 2nd, appearing in your issue of April 13th, 1928.

We believe the letter is written in connection with the publication circulated by Messrs. Rothman & Co., the tobacconists, consisting of a twenty-four-page magazine, illustrating numerous articles and purporting to show a certain "Thor" electric suction sweeper, embellished with the following description:—

> "The only cleaner of its type embodying the following features: No dust, no lubrication, no noise, no gears, no wear or running costs. With ball-bearings, longer life, double fan, greater suction, and patent friction drive. The 'Thor' creates its own powerful suction just by gliding over the carpets—thoroughly cleaning them and reviving the nap at the same time. A fully guaranteed all-British cleaner."

We manufacture "Thor" products and own the "Thor" trade mark. Our "Thor" appliances are manufactured in the United States, each appliance being plainly marked to

this effect. It is obvious that the description and specification indented above does not pertain to "Thor" products.

You have our assurances that immediate protest was made against the unfair, unethical, and unauthorised action of the house in question. The enclosed facsimile letter written by this firm is self-explanatory.

"Thor" products are not available for distribution by this house under any condition, and Messrs. Rothman & Co. have agreed to submit all inquiries for "Thor" products to us, and make no attempt to supply "Thor" products to the members of their Association.

Hurley Machine Company,
M. A. HUSSEY, *General Manager.*

London, *April 13th*, 1928.

[The letter enclosed contains Messrs. L. Rothman & Co.'s admission that in advertising a hand-operated British-made cleaner, "through some error the correct description was inserted, but the name, illustration, and price of the 'Thor' cleaner were given"; they confirm that the Hurley Machine Company did not permit them to sell its cleaners at any other than the full retail price.—EDS. ELEC. REV.]

Spare-time Businesses.

In the Dartford County Court on April 2nd, a man who stated that he was an electrical engineer employed by Messrs. Vickers, sued for payment due for electrical contracting work carried out in his spare time. The evidence made it clear that at one time this electrician had as partner another of Messrs. Vickers's employés in this spare-time company.

In the first place, is this kind of thing just to the shareholders of Messrs. Vickers? Secondly, is it not unfair to electrical contractors?

If employés of any firm are allowed to carry on a private business in their spare time, especially work involving manual labour, then I submit these employés cannot give of their best to the firm. There are other and more serious considerations which I need not mention.

Electrical contractors who have to depend on contracting for their living should not be called upon to tolerate such unfair competition. These contractors are expected to pay trade-union rates of wages and they have standing charges, to say nothing about rates and taxes.

I wonder what the directors of Messrs. Vickers would say if their employés formed a spare-time company to compete with them!

A. J. Abraham.

Electricity and Tramways Dept., Bexley.
April 3rd, 1928.

Impregnation of Insulation.

A free and open discussion would seem desirable, as suggested by Mr. Fogarty in your issue of the 6th instant, but whether this is likely to be obtained is another matter.

Two of the three principally interested parties, namely, the varnish manufacturer and the user, naturally hesitate to broadcast information which is the result of costly hard-earned experience and as often as not is regarded, more or less, as of the nature of secret processes or trade secrets; consequently the remaining interested party, the impregnating-plant manufacturer, has full scope and an open field to exploit the situation to full advantage, and incidentally befog the whole question in his endeavour to create the impression that his plant is the most important item in the whole process of impregnation. In point of fact, it is the least important of all, depending as it must upon the materials to be handled and the ultimate result aimed at. The plant is the "means to an end" and not *vice versa*; yet it would seem that all the inherent disabilities, physical and chemical, of the materials under treatment, and those of a psychological nature in *personnel*, would immediately be overcome by the adoption of various gadgets and contraptions put forward by the plant manufacturer.

The forming of insulation by impregnation may be considered analogous to scientific cooking, the essential factors being: *the material, the recipe*, and *the cook*. It will be appreciated that the most expert chef cannot produce a good omelet from a bad egg, however perfect his cooking utensils, and likewise good insulation depends primarily upon the varnish and not upon the plant.

Solvent extraction and recovery, condensers, and the like, have been referred to in connection with the plant without discrimination as to the materials under treatment. As to the necessity of these, it only need be said that the drying of oil varnishes is not due to evaporation (as in the case of alcohol varnishes) but to the oxidising action of oxygen in the air whereby a coherent film of oxines is formed. Thus the solvent and/or diluent for oil varnishes should not be of such a nature as to require expulsion.

As regards the vacuum, a figure of 30 in. has been mentioned as desirable; there appears to be no reason for this other than to impress one with the importance of the plant. The function of the vacuum is merely to assist the removal of moisture by evaporation at a lower temperature than the boiling point of water at atmospheric pressure, 100 deg. C., which is too near the temperature at which cotton and silk are damaged. Therefore a good commercial vacuum is all that is necessary in order that the temperature of evaporation may be sufficiently far removed from the point where damage might result.

The temperature indicator should be of the thermo-couple or pyrometric type.

In conclusion, it may be questioned whether the term "combined vacuum-pressure system" is a happy choice.

C. W. Crosbie.

Northampton, *April 7th*, 1928.

Wayleaves.

The Overhead Lines Association has undertaken to compile data concerning suitable agreements, notices, terms, &c., for the guidance of the Electricity Commissioners. This matter is of very great importance, as a carefully agreed basis that is fair to all parties will greatly facilitate the distribution of electricity in rural areas. This Association was able to give much useful information to the Electricity Commissioners, in connection with the revision of their Overhead Lines Regulations, also members of the Council were able to personally assist in the matter. The Association is anxious to keep up its reputation, and therefore would be glad to receive notes from all those who have had experience in dealing with wayleaves (addressed to our hon. secretary, Mr. Theodore Stevens, 50, Lincoln's Inn Fields, E.C.2.). Already, thanks to the initiative of our hon. secretary, we have been able to analyse a number of existing forms for the Commissioners in such a novel way as to show what a number of omissions occur even in the best of these forms.

Points that should be borne in mind are the following:—*Acts* subject to and rights reserved.—*Landowners' obligations*; notice before erecting buildings; moving of wires; indemnities.—*Electricity Suppliers' obligations*; route; carrying-out of works; making good; indemnities.—*Local Authorities' obligations.—Notices*; new works; to alter; to terminate agreements; to restore; to lop or fell.—*Payments*; to landlords; to tenants for life; to leaseholders; to annual tenants; classes of poles; classes of land (arable, grass, or pasture); underground cable; damage to crops during construction; rates and taxes.—*Arbitration of Disputes.—Publicity.*

We have to thank the ELECTRICAL REVIEW for the publicity given to our last letter appealing for assistance on overhead lines regulations, to which we had an excellent response.

R. Borlase Matthews,
President, Overhead Lines Association.

London, *April 10th*, 1928.

The Maintenance of Motors, Starters and Controllers.

The article in your current issue under the above heading is to a very great extent a reprint of a booklet first published over ten years ago by Mr. George Ellison, under the title of "Hints on Rectifying Faults in Motor Control Gear," which was favourably reviewed in your issue of August 3rd, 1917.

Presumably Mr. E. Daine Dawson and his collaborator are members of that firm's staff, and so can quote from its publications without referring to the fact.

I think, however, it would have been fairer to have indicated that the article was in the main a reprint of the above booklet; and it would also give those engineers who desire to do so an opportunity of acquiring in a handy compact form the very interesting information therein contained.

I take it that the "7" in the sentence "and the other two legs (of the rotor resistance) are subjected to 7 per cent. excess pressure" is a misprint. With a star-connected rotor it would be 70 per cent., as the booklet points out.

A. N. D. Kerr.

Barnes, *April 14th*, 1928.

The article in the current number of the ELECTRICAL REVIEW entitled "The Maintenance of Motors, Starters and Controllers," is almost a copy of our booklet "Hints on Rectifying Faults" which you were good enough to review in 1917.

We enclose one of our booklets for you to compare with the article by your contributors. Unless it is intended to make due acknowledgment, we feel sure you will agree that this is a particularly bad case of plagiarism which you would not wittingly have permitted.

For **George Ellison,**
WM. F. W. HARPER,
Advertising Manager.

Birmingham, *April 16th*, 1928.

[We have compared the article in question with the excellent little book issued by Mr. George Ellison, and regret to find that, as our correspondents point out, the matter published in our last issue is practically identical with that in the booklet. Most of the concluding instalment, appearing elsewhere in this issue, is free from that criticism. Apologising to Mr. Ellison, we hardly need say that the article would not have been accepted had we recognised its character.—EDS. ELEC. REV.]

Refuse Disposal Plant at Dundee.

The Dundee Corporation Cleansing Committee on April 13th approved a scheme for the installation of a centralised salvage and refuse disposal plant, at a cost of £30,000.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

The Contractors' Conference.

We have received the provisional programme of the third annual conference of the E.C.A. Allied Associations which is to be held at Cheltenham on July 4th, 5th, and 6th next. The first day, as in previous years, is devoted to a meeting of the Council of the three associations and the arrival and registration of delegates, and the evening to a reception by the president (Mr. W. A. Shaw) and conversazione. The annual general meeting is to be held on the following day (July 5th). Subsequently the mayor of Cheltenham will give an address of welcome, and Mr. Shaw will deliver his presidential address. After luncheon, papers will be read by Mr. W. R. Rawlings ("Earthing as a Safeguard to the Public"), and Mr. J. Orringe ("Electrical Development, with Special Reference to Retail Sales"), and discussions will follow. In the evening there is to be a smoking concert. On Friday, July 6th, Mr. H. Marryat will read a paper on "Trading without Tears: The E.C.A. Policy." This will be followed by votes of thanks, and the installation of the new president, who will deliver a short address. A garden party will be given in the afternoon in the grounds of Pittville Park, and in the evening the mayor has invited the delegates to a ball and supper. The meetings and other functions are to be held in the Town Hall. Arrangements have been made for delegates who wish to stay in Cheltenham during the week end. The programme makes a special note of the fact that ladies are welcomed and that arrangements for their entertainment during the business sessions are being made. Views of the town illustrate the programme and in themselves are an invitation. Another useful feature is a pictorial map of adjacent places of interest. The programme includes the necessary registration and railway voucher cards.

The Timber Market.

Our Timber Trade Correspondent reports that the demand for wood generally is only of a moderate character. Deliveries of European softwoods into consumption are not so large as in the spring of 1927, but an improvement is expected. The new shipping season is about to open, and supplies to come forward will be lighter, for besides the important fact that United Kingdom importers are not operating on nearly such a large scale as in 1927, the recent lock-out in the Swedish sawmills, which extended over 2½ months, must have a considerable effect on the usually large production of that country. Shippers' rates are much higher than are being obtained, comparatively, on the spot, and the latter are expected to firm up as the season advances. Hardwoods of the better grades are only of limited supply, and prices for these are well maintained. The inferior qualities are in good stock, but efforts are being made in the United States to reduce the cut, which, if successful, are likely to have the effect of diminishing supplies and raising prices.

Our Foreign Electrical Trade.

The following were the values of imports and exports of electrical goods and machinery during March, 1928:—

	Mar., 1928.	Inc. or dec. as compared with Mar., 1927.	3 months, 1928. Inc. or dec.
	£	£	£
Imports—			
Electrical goods and apparatus ...	357,725	+ 29,737	+ 184,417
Machinery ...	1,528,677	+184,207	+ 357,198
(inc. electrical machinery) ...	157,772	+ 19,044	+ 79,487
Exports—			
Electrical goods and apparatus ...	1,100,492	+140,705	+ 16,313
Machinery ...	4,812,947	+678,367	+1,937,517
(inc. electrical machinery) ...	644,432	+ 66,828	+ 37,510
Re-exports—			
Electrical goods and apparatus ...	12,574	− 920	− 614
Machinery ...	137,611	− 5,881	+ 28,677
(inc. electrical machinery) ...	13,665	+ 4,870	+ 6,757

Receiver Appointed.

N-K. (BRADFORD), LTD.—Mr. R. G. Sidford, Cecil Chambers, 76, Strand, W.C.2, announces that he has been appointed receiver of the assets of this company by the debenture holders.

Unemployment.

During the week ended April 2nd there was an increase of 8,060 in the number of registered unemployed, bringing the total up to 1,041,900. On April 4th, 1927, the total was 1,073,760.

The Wireless Retailers' Association.

In his report to the recent annual general meeting of this Association, Mr. F. S. Horsey (chairman) referred to the affiliation of the South Wales Wireless Retailers' Association, and expressed the hope that other local associations would follow its lead. He said that a gratifying increase in membership was the result of the Association's participation in last year's exhibition at Olympia. The campaign, having for its object the restriction of discounts to *bona-fide* traders, had proved more successful than they had anticipated; more than 150 manufacturers and factors had notified their support of the scheme. Mr. Horsey said that only complete organisation would put the trade upon a proper footing.

The Sale of Fittings at Torquay.

At a recent meeting of the Torquay Electricity Committee the electrical engineer, Mr. H. F. G. Woods, reported that under Section 48 of the Electricity (Supply) Act, 1926, the Corporation was empowered to sell electrical apparatus and fittings, and he recommended that this power should be exercised through the showrooms by the sale of apparatus and fittings direct to consumers. The Committee resolved that selling powers should be exercised in accordance with the terms of an agreement with the local electrical contractors, to be prepared by the Town Clerk, and that the arrangement should operate for a period of twelve months, at the end of which the matter should be reviewed in the light of experience gained. The Committee instructed the engineer to communicate the decisions to the secretary of the local branch of the Electrical Contractors' Association.

The Sale of Fittings at Guildford.

The Guildford Corporation Electricity Committee has asked the borough electrical engineer to prepare a scheme in connection with the sale, &c., of electrical fittings, and the Committee is to confer with the principal contractors in the town with regard to the matter.

New French Company.

A company has been formed in Paris (241, Boulevard Saint Germain), with a capital of three million francs and the title La Société Financière pour le Developpement de la Traction Electrique par Accumulateurs (Procédés Ed. Parville).

Great Britain's Radio Exports.

The *Wireless Trader* reports that the total value of exports of radio apparatus from this country during February was £132,474 (including re-exports of £2,570). This was the highest figure ever reached in a single month, being over £40,000 above the January figure. By far the most important market was Japan, whose share amounted to £36,594 (valves £5,702). Shipments to South Africa reached a value of over £14,000, of which the Transvaal took £12,132 (valves £1,279). The Netherlands accounted for £10,867 (valves £134), Australia and New Zealand for £11,344 (valves £3,735), and India and Burma for £5,945 (valves £426).

Recent Contracts.

Among orders recently placed with the BRITISH THOMSON-HOUSTON CO., LTD., Rugby, for traction equipment are one from the Manchester Corporation Tramway Department for 30 traction motors and 50 controllers, and another from the Sheffield Corporation Tramway Department for 100 controllers and 25 lightning arrestors. On both systems there are already some hundreds of the same type of controller in use, while the Manchester order for motors is the second repeat order for B.T.H. 50-h.p. motors of this particular type.

The Swiss Industries Fair.

Electric calculators, clocks, heaters and ovens are amongst the exhibits at the twelfth Swiss Industries Fair, which is being held in Bâle from April 14th-24th. More than a thousand exhibitors, representing practically every branch of Swiss industry, are taking part, each separate industrial group being housed in a hall of its own in the new Fair buildings, erected at a cost of £500,000. Buyers from thirty different countries are attending the Fair.

The Seventeenth Illumination Conference.

We have received the programme of the 17th Illumination Conference which is to be held at the London Lighting Service Bureau from April 30th to May 4th. An attractive series of lectures and visits has been arranged, and the field covered is a very wide one.

Conditions in Sweden.

A recent D.O.T. report by Mr. H. Kershaw, O.B.E., Commercial Secretary at Stockholm (Stationery Office, 1s. 6d. net), says that, speaking generally, the Swedish engineering industry is still suffering from the effects of the post-war crisis. Export markets have been lost, and the requirements of the home market materially reduced. Employers have found it essential to concentrate upon the reduction of the costs of production, and in some cases this has been accompanied by the dismissal of workers. One works, by the use of highly-developed labour-saving machinery, is producing considerably more at less cost, the number of hands being about 2,700, as compared with 4,000 in 1920. There has apparently been a revival in the electrical branch, for one large works increased the number of its workers by 30 per cent during 1927. On the whole, says Mr. Kershaw, the Swedish engineering industry is slowly retrieving its position, but it will probably still take several years before fair dividends can be paid on the capital invested. The business in radio apparatus is said to be satisfactory. The tendency to purchase parts has given place to the buying of complete sets, and there has also been a change-over from crystal to valve receivers. Most of the sets are of Swedish manufacture, but a great deal of German apparatus is imported. There is a tendency towards an increased demand for high-quality goods. British manufacturers are urged to study the Swedish market more closely and to give the greatest consideration to the reports of representatives who have visited the country.

Trade Announcements.

Mr. A. W. FINN has relinquished the position of manager of the Worthing branch of Superlamp, Ltd., and has joined the board of Lambert Laws, Ltd., successors to the Electric and Radio Service, 15, Gloucester Place, London Road, Brighton.

Mr. A. KELLY, formerly London agent to Messrs. W. Goodyear & Sons, Ltd., for the sale of "Greenbat" electric trucks and locomotives, has been appointed London agent to Messrs. Wingrove & Rogers, Ltd., 188-9, Strand, W.C.2, for the sale of "B.E.V." electric vehicles.

Mr. L. P. HASLER, electrical and radio engineer, is shortly opening premises at 21, High Street, Chelmsford.

A wireless salon was opened recently by Messrs. E. T. ROBERTS, LTD., of The Crescent, Carlisle.

M. MAURICE BOBIN has removed to 15, Farringdon Avenue, E.C.4. Telephone: City 3880.

The RAY ENGINEERING Co., Bristol, has appointed Mr. J. S. Plumtree, 90-91, High Holborn, W.C.1, sole agent in London and district. The company has just completed its new Waterdale Works, where all kinds of switchboards and switchgear will be manufactured.

Messrs. WOOD & CAIRNS, LTD., have removed to new premises (including showrooms) at Argyll House, 11, Queen Street, and North-East Thistle Street Lane, Edinburgh.

Messrs. OPENSHAW & Co. have taken over the business of Mr. J. H. Corlett, electrical engineer, of 55a, Bucks Road, Douglas, Isle of Man.

On April 16th the MACINTOSH CABLE CO., LTD., removed its sales and estimating departments from Derby to St. James's House, St James's Street, London, S.W.1, which now becomes the head office of the company. 'Phone: "Gerrard 5812." Telegrams: "Intoshmac, Piccy, London."

A telephone and electrical engineering and trading company has been registered under the name of GARDNER, BROWN AND CO., LTD., and has taken over the business of Mr. E. G. Brown, of Whitecross Place, E.C. The address of the new company is 131, Finsbury Pavement, E.C.2.

New Catalogues and Lists.

MR. A. G. ALEXANDER, 65, Fulwood House, High Holborn, W.C.1.—A card illustrating an electric burglar alarm.

THE CANADIAN PORCELAIN CO. (BRITISH), LTD., 343, Abbey House, Victoria Street, S.W.1.—Catalogues Nos. 404 and 405, illustrating and describing a large number of the company's switch and line insulators.

MESSRS. T. HARDING CHURTON & CO., LTD., Atlas Works, Water Lane, Leeds.—List No. 705, containing particulars and prices of two- and three-phase induction motors. A complete private code is embodied in the list.

THE ELECTRICAL EQUIPMENT & CARBON CO., LTD., 107-111, New Oxford Street, W.C.1.—April stock list of motors, generators, lamps, carbons, &c.

MESSRS. J. A. CRABTREE & CO., LTD., Lincoln Works, Walsall.—"The Crabtree," a little magazine dealing with the company's switches from various angles, as well as with general matters. Also Leaflet No. 1026, containing illustrations and prices of a new "Home Office" pattern switch-lampholder.

BAKELITE, LTD., 68, Victoria Street, S.W.1.—An illustrated brochure dealing with "Bakelite" moulding materials and their employment. The materials described include "Formite," "Redmanol," and "Mouldensite."

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—The "Osram-G.E.C. Bulletin" for April, in which a number of "Osram" lighting installations are described and illustrated. There are also interesting articles and notes on other phases of the company's activities.

THE ENGLISH ELECTRIC CO., LTD., Queen's House, Kingsway, W.C.2.—A pamphlet (No. 911), illustrating and describing the company's motor convertor.

MESSRS. FERRANTI, LTD., Hollinwood, Lancs.—Publication Wa415/1A, bearing particulars and prices of power resistances from 2,000 to 100,000 ohms for radio work.

MESSRS. ROBERT MCGREGOR & CO., Alpine Steelworks, East Molesey, Surrey.—Lists Nos. 124 and 136, dealing respectively with mild steel cable hangers and racks, and cable rollers. Priced.

THE BRITISH THOMSON-HOUSTON CO., LTD., Mazda House, Newman Street, Oxford Street, W.1.—A mailing card advertising the B.T.-H. shop-window floodlight.

MESSRS. WATSON & SONS (ELECTRO-MEDICAL), LTD., 43-47, Parker Street, Kingsway, W.C.2.—Bulletin No. 93, containing fully illustrated particulars and prices of "Sunic" X-ray apparatus for use with "Metalix" tubes.

THE ALFA-LAVAL CO., LTD., 34, Grosvenor Road, S.W.1.—Supplement No. 10, with general catalogue, describing, with illustrations, the company's apparatus for the purification of switch oils.

VAC-TRIC, LTD., Broadway Works, Cricklewood, N.W.2.—A leaflet illustrating and describing the company's vacuum cleaners. Priced.

THE HOTPOINT ELECTRIC APPLIANCE CO., LTD., 24, Newman Street, Oxford Street, W.1.—List No. 338, a catalogue of electric water-heating apparatus, including immersion heaters, storage tanks, hot-water radiators, wash boilers, &c. Illustrated and priced.

SIEMENS ELECTRIC LAMPS & SUPPLIES, LTD., 38-39, Upper Thames Street, E.C.4.—April price list of electrical apparatus, accessories and supplies of all kinds.

MESSRS. DORMAN & SMITH, LTD., Ordsal Electric Works, Salford, Manchester.—Leaflet No. 101, containing illustrated particulars of flameproof interlocked switchgear. Priced.

THE STURTEVANT ENGINEERING CO., LTD., 147, Queen Victoria Street, E.C.4.—Catalogue 1235, a comprehensive descriptive list of the company's fans, apparatus, plant and systems for dust-collecting, ventilation, forges, coal crushing, &c.

Bankruptcy Proceedings.

F. A. HARTLEY and R. HARTLEY, trading as F. A. Hartley and Son, 98, Katherine Street, Ashton-under-Lyne, electrical engineers.—These debtors' application for discharge was heard recently at the Town Hall, Ashton-under-Lyne. The receiving order was made in 1926. According to a statement of affairs, submitted in October, 1926, the liabilities were estimated at £687, against assets of £168, although they actually realised £181. A first and final dividend of 3s. 6½d. in the £ was paid. The debtors became aware of their position in September, 1925, when the assets were not equal to 10s. in the £, but they continued to trade and contracted two more debts with moneylenders. Debtors attributed their failure to lack of capital, bad trade, keen competition, and illness. They paid £400 for the business and undertook to pay the widow of the late proprietor £1 a week until her son became 16 years of age. That money would reach about another £400. The solicitor said the senior debtor had no intention of commencing business again, but his son desired his discharge to enable him to recommence as soon as possible. The discharge was granted, subject to 12 months' suspension.

H. A. HISCOX, 1, Stanley Mansions, Marine Road, S.W.17, lately of 52, Queen Victoria Street, E.C.4, engineer.—The following are creditors:—

	£		£
Times Publishing Co., Ltd.	67	Nalder Bros. & Thompson, Ltd.	75
Crompton - Parkinson, Ltd.	648	Hunt, Blackman & Co.	42
Igranic Electric Co., Ltd.	20	Holmes, W. F.	33

A. RAUTANEN, electrical, mechanical and wireless engineer, 17, Princess Street, Shrewsbury.—Receiving order made April 5th on debtor's own petition. First meeting April 20th, at the Official Receiver's offices, 22, Swan Hill, Shrewsbury. Public examination June 4th, at the Shire Hall, Shrewsbury.

H. A. HYDE, wireless dealer, 148, Weston Park, Crouch End, N., late of Bromley.—First meeting April 23rd, at 29, Russell Square, W.C. Public examination May 17th, at the County Court, Croydon.

O. L. JONES (Jones & Evans), wireless dealer, Castle Buildings, Pontardulais.—Receiving order made April 4th, on debtor's own petition.

Company Liquidations.

FRY & Co., LTD., Manchester, electrical engineers.—At a meeting of creditors on April 3rd, at the offices of Messrs. Harry L. Price & Co., 47, Mosley Street, Manchester, Mr. A. T. Eaves, liquidator, submitted a statement of affairs which disclosed ranking liabilities of £3,881, of which £1,681 was due to the trade, and £2,200 to a cash creditor. The assets were estimated to realise £1,720 and £1,149 net, leaving a deficiency, so far as the creditors were concerned, of £2,732.

The total deficiency, as regarded the shareholders, was £4,715. There had been losses on the trading aggregating £2,463. The deficiency, as regarded the shareholders, was accounted for by those losses, together with the writing down of the assets in the statement of affairs, by sums totalling £2,251. The company was registered in 1923, with a nominal capital of £2,100, to take over an existing business, but since its inception it had never made a profit. Last October a retail shop was opened at Gatley, and on January 1st another was opened at Chorlton. Neither of them appeared to have been successful. The Chorlton shop had since been closed, but the other establishment at Gatley might be sold. The debenture was held by one of the directors, who had also advanced the company £2,200. A resolution was passed confirming the voluntary liquidation of the company, with Mr. Eaves as liquidator, and an advisory committee was appointed, consisting of Mr. J. Moores (J. Moores & Co.), Mr. F. P. Deyes (B.N.B. Wireless, Ltd.), and Mr. L. Mottram (London Electric Wire Co. and Smiths, Ltd). The following are creditors:—

	£		£
Baxendale & Co., Ltd.	29	Hughes, F. A., & Co., Ltd.	20
B.N.B. Wireless, Ltd. ...	297	London Electric Wire Co. & Smiths, Ltd. ...	137
Brandes, Ltd.	31	London Metal Warehouses, Ltd.	29
Britain's Best Crystal, Ltd.	23	Metro-Vick Supplies, Ltd.	53
Concordia Electric Wire Co., Ltd.	61	Moores, John, & Co. ...	446
Crypto Electrical Co., Ltd.	72	Oldham & Sons, Ltd. ...	38
Efandem Co., Ltd. ...	46	Royal Accumulator Co.	38
Ferranti, Ltd.	109	Smith, Fredk., & Co. ...	21
Finston Mfg. Co., Ltd.	24		
Gottlieb, J. L.	67		

Readers, Ltd., Henrietta Street, W.C.2, wireless factors and electrical dealers.—A meeting of creditors was held on April 4th, when Mr. George, of Corfield & Cripwell, representing Messrs. Johnson & Phillips, Ltd., the largest unsecured trade creditors, presided. Mr. George Weir presented a statement of affairs which disclosed liabilities of £1,097, all due to unsecured creditors. The total assets were £1,091, leaving a deficiency of £6, subject to the costs of liquidation. The company was incorporated in February, 1920, with a nominal capital of £4,000, of which £2,820 was issued for cash. The creditors decided to appoint Mr. W. A. J. Osborne, Balfour House, Finsbury Pavement, E.C., as joint liquidator with Mr. Weir. A committee of inspection consisting of three of the creditors was also appointed. The following are creditors:—

	£		£
Baron G. Masochitti ...	30	St. Helens Cable & Rubber Co., Ltd.	167
Brown & Hall	40	Electric Street Lighting Apparatus Co.	66
Macgreagar, C. W. ...	94	Reader, C. W.	51
Heathman, J. H.	27		
Johnson & Phillips, Ltd.	499		

Notable Electric Co., Ltd.—The following are creditors under this liquidation:—

	£		£
Lyle, B. G., Ltd. ...	494	National Bank, Ltd. ...	159
Benet, P.	131	Teale & Cox	42
Burton, B. S., Ltd. ...	69	Warner, F.	645
Dunn, M., Ltd.	64	Williams & Co.	66

Thompson, Young & Co., Ltd., radio and electrical engineers, 26a, Bebington Road, Lower Bebington, Ches.—The statutory meeting of creditors was held on April 11th at Liverpool, when Mr. P. S. Booth, liquidator in the voluntary liquidation of the company, submitted a statement of affairs which showed liabilities of £1,384. The assets totalled £391, leaving a deficiency, so far as the unsecured creditors were concerned, of £993. The issued share capital of the company amounted to £900, making a total deficiency of £1,893. The company was incorporated in 1926, with a nominal capital of £2,000. A full set of books had been kept and regular accounts prepared. The creditors resolved to confirm the voluntary liquidation of the company with Mr. Booth as liquidator, and an advisory committee was appointed, consisting of the representatives of the General Electric Co., Ltd., G. P. Dennis, Ltd., and Willmer Bros., Ltd. The following are creditors:—

	£		£
Brandes, Ltd. ...	27	Dennis, G. P., Ltd. ...	58
British Thomson-Houston Co., Ltd. ...	25	Bankers	305
General Electric Co., Ltd.	139	Wilmer Bros. & Co., Ltd.	25
		Young & Sons	25

Kingsway Radio, Ltd.—A meeting of members is called for May 14th, at 3, Cannon Street, E.C., by the liquidator, Mr. W. C. Todd.

Metropolitan Electric Wire Co., Ltd.—Last day for proofs for dividend, April 30th. Mr. E. T. A. Phillips, Official Receiver and Liquidator, Carey Street, W.C.

Standard Cable Manufacturing Co., Ltd.—Liquidator, Mr. H. E. Purgess, senior Official Receiver and Liquidator, Carey Street, W.C., released April 11th.

Church Stretton Electric Supply Co., Ltd.—Winding up voluntarily. Liquidator, Mr. A. E. Dalton, 26, Woodend Road, Winton, Bournemouth. The liquidator is authorised to carry into effect the agreement for the sale of the company to the Shropshire, Worcestershire & Staffordshire Electric Power Co.

Abies Battery Co., Ltd.—A meeting of members is called for May 7th, at Leith House, 47, Gresham Street, E.C., to hear an account of the winding up from the liquidator, Mr. T. Dudley Corke.

Dissolutions of Partnership.

S. T. Corry & Co., wireless and electrical dealers, 52a, Southampton Row, W.C.—Mr. S. M. Fox and Mr. A. H. Tappy have dissolved partnership. Mr. Fox will attend to debts and continue the business.

J. Harrison & Co., electrical contractors, King's Cross, Halifax, and 14, York Street, Clitheroe.—Messrs. J. Harrison, N. S. Jackson, and H. Elliott have dissolved partnership. The business at King's Cross, Halifax, will be carried on by Mr. J. Harrison and Mr. N. S. Jackson under the same style, and the business at 14, York Street, Clitheroe, will be carried on by Mr. H. Elliott.

Private Arrangements.

A. W. Hosking, radio engineer, 45, Whitechapel, Liverpool.—A meeting of creditors was held recently at the offices of Mr. P. S. Booth, Liverpool. The statement of affairs presented showed ranking liabilities of £855 and net assets of £108, leaving a deficiency of £747. The debtor commenced trading from his father's house in 1924, with a capital of £30. He carried on business successfully, and in August, 1926, removed to his present address. During the year to February 28th, 1926, the turnover was £1,038, with a net profit of £160, and in the following year the sales increased to £1,893, but the net profit declined to £50. The drawings had been small. The present position was attributed to heavy overhead expenses and insufficient takings. A resolution was passed confirming the deed of assignment already executed. The following are creditors:—

	£		£
Allen, Wm., & Co. ...	122	General Electric Co., Ltd.	41
British Thomson-Houston Co., Ltd.	38	Pulford Bros., Ltd. ...	53
Brandes, Ltd.	24	Parkinson, —	51
Burnett & Co.	31	Highcock, G. H. & R. ...	20

The London Chamber of Commerce.

The 46th annual report of the Chamber, covering the year ended December 31st last, is a record of activities in many and various directions. The Electrical and Allied Trades Section (chairman, Mr. P. M. Rossall; deputy-chairman, Mr. A. M. Sillar) had under consideration the developments under the Electricity (Supply) Act, 1926; inquiries under the Merchandise Marks Act, 1926, affecting electrical goods; the exclusion of transformer street boxes and kiosks from the Factories (No. 2) Bill, which was secured; the draft British Standard Specification for varnish-paper boards and tubes (synthetic resin), and a number of other matters.

During the year the British Electrical Development Association became affiliated to the Chamber.

For Sale.

Paignton Electric Light & Power Co., Ltd., invites offers for surplus plant owing to the taking of a bulk supply; Landport Drapery Bazaar, Ltd., has for disposal several gas engine generating sets, switchboards, booster set battery, motors and fans. Colne Corporation Electricity Department has for disposal one Premier water cooling tower, capacity 210,000 gallons per hour. Stoke-on-Trent invites offers for one 600-kW, d.c. turbo-dynamo. Messrs. Fuller, Horsey, Sons & Cassell will sell by auction on May 3rd, at the Machinery Depot, Erith, Kent, by order of the directors of Vickers-Armstrong, Ltd., engineers' machine tools, electric motors, &c. Clacton U.D.C. Electricity Department has for disposal one 266-cells storage battery, reversible boosters, and milking booster. Plymouth Corporation Stores Committee invites offers for surplus plant. (See our advertisement pages to-day.)

The Terror of the Telephone.

We have often said that methods which are successful in the United States would not be tolerated in this country. Selling vacuum cleaners by telephone appears to be one of them. According to a writer in *Electrical Merchandising* who has employed this system, this is the way it's done:—

"The salesman's call was answered by a woman's voice; he asked for 'Mr. Jones,' and was told that he was not in; the woman wanted to know who was calling, a request that the salesman brushed by—by asking if he was speaking to Mrs. Jones; she tells him he is speaking to Mrs. Jones, and wants to know who is calling. The salesman again ignores this question by asking her: '*Mrs. Jones, are you going to buy a new vacuum cleaner* (or washer or other appliance) *this week?*' Note that he asks her, point blank, if she is going to BUY. He doesn't ask her if she is interested, or if she will 'consider' one. And, to avoid the possibility of receiving a definite answer, he asks her if she is going to buy one *this week*. Bear in mind that this brutally point-blank question is wholly unexpected and comes 'out of a blue sky,' after the woman's curiosity has already been more than a little piqued. It comes to her in a rising, expectant voice that seems to say, without actually expressing the words, that you know that either he or she is going to buy the appliance. The effect of the question is momentarily unbalancing to her, *and in this moment of unbalance you determine whether or not she is a prospect.*"

New Swiss Financing Company.

The formation is impending of a new financing undertaking under the title of the Swiss-American Electricity Company. Besides the Motor-Columbus Company, of Baden, and the South American Electricity Company, of Zurich, it is stated that the participants in the new concern are a Swiss banking group and banking firms in New York. The share capital and reserves of the new company will amount to 130,000,000 fr., of which 51 800,000 fr. will be subscribed in 6 per cent. preference shares by the New York firms.

Local Exhibitions.

ABERDEEN.—Under the auspices of the local E.D.A. Circle an exhibition of electrical appliances was held in the Music Hall, Union Street, from April 9th to 14th. Although a charge of 6d. was made for admission, there was a very satisfactory attendance. Special lectures and demonstrations were given daily by representatives of exhibiting firms, and music was provided by the band of the Royal Scots Greys. The following had stands:—British Insulated Cables, Ltd., Claud Hamilton (Aberdeen), Ltd., the Aberdeen Electrical Engineering Co., Ltd., Lawson, Turnbull & Co., Ltd., T. C. Smith & Co., Ltd., the Edison Swan Electric Co., Ltd., A. B. Robertson & Son, Ltd., the Aberdeen Corporation Electricity Department, Alexander Spark, Carnegie & Watson, Ltd., James Thomson ("Revo" appliances), John F. Anderson, Andrew McRobb, Bell & Robertson, Ltd., the General Electric Co., Ltd., Metro-Vick Supplies, Ltd., Burnley Components, Ltd., the Falkirk Iron Co., Ltd., Siemens Electric Lamps & Supplies, Ltd., the British Thomson-Houston Co., Ltd., Credenda Conduits Co., Ltd., and Belling & Co. The catalogue contained particulars of the charges for electricity supply, the hire of appliances, &c., in the city.

FLADBURY.—In continuation of its series of electrical displays, the Shropshire, Worcestershire and Staffordshire Electric Power Co. is this week holding an exhibition at the Institute, Fladbury (from April 17th to 20th). A number of contractors in the area are participating in the display.

Book Notices.

"Reid's Handy Colliery Guide for Northumberland, Durham, Yorkshire, Cumberland and Westmorland." Pp. 242. Newcastle-upon-Tyne: A. Reid & Co., Ltd. Price 3s. 6d.—This handy guide and directory to the coal industries of the North of England for 1928 has been carefully revised from the latest official returns and other sources; a colliery map giving the positions of collieries, as well as the railways and stations for Northumberland, Durham and Yorkshire is included; and also the Coal Mines Act, 1911, with various statutory rules and orders issued since the Act came into force.

"South African Mining and Engineering Journal Year Book and Directory for 1928." Pp. 590. London: Argus South African Newspapers, Ltd. Price 12s. 6d.—This standard reference book on mining, engineering, and allied industries contains articles in its electrical section on:—Power supply in South Africa during 1927; automatic telephony in South Africa; the largest convertor station in South Africa, *viz.*, the Johannesburg Municipal Council substation; the Congella power station; the Victoria Falls and Transvaal Power Co., Ltd.; transformer manufacture in South Africa; and a complete list of the South African public electric supply undertakings. Other sections include engineering, industrial matters, railways, transport mining and Rhodesia and the Congo. It also contains lists of overseas manufacturers represented in and British overseas manufacturers and exporters to South Africa, and a buyers' list of municipal, mining, railway and industrial buyers, &c.

"Callender Overhead Construction" (pp. 243, ill.). London: Callender's Cable & Construction Co., Ltd.—This is a treatise upon the subject of overhead lines generally and Callender's methods particularly. The matters covered include transmission and distribution lines, railway electrification, cable bridges, &c. A great deal of attention is devoted to "Caliender Kay" towers, and there are numerous illustrations of work carried out by the company's engineers. The nominal price of the book is 10s.

"The Sixth Sense and Other Studies in Modern Science," by D. F. Fraser-Harris. Pp. vii+174. London: G. Routledge & Sons, Ltd. Price 5s. net.

"Classified Examples in Electrical Engineering," by S. Gordon Monk. Vol. I—Direct Current. Pp. vii+77; illustrated. Price 2s. 6d. net. Vol. II—Alternating Current. Pp. viii+115; figs. 11. Price 3s. 6d. net. London: Sir Isaac Pitman & Sons, Ltd.

"Talks and Lectures—April to July, 1928." Pp. ii+42. London: British Broadcasting Corporation.—This new syllabus proves that listeners of all tastes are being catered for.

"Post Office Electrical Engineers' Journal." Vol. XXI. Part I. April, 1928. London: ELECTRICAL REVIEW, Ltd. Price 1s. 3d. net.

"Kempe's Engineer's Year Book for 1928." Pp. lxxxi+3,169. Illustrated. London: Crosby, Lockwood & Son. Price 30s. net.

"The Quantum and its Interpretation," by H. Stanley Allen. Pp. xiii+274. London: Methuen & Co., Ltd. Price 12s. 6d. net.

Australian Exhibition Postponed.

It is reported that the Federal Government has decided to postpone the British Empire Exhibition, which was to have been held in Sydney in 1930, until 1931.

Social Event.

The travellers of the General Electric Co., Ltd., held their annual dinner at the Connaught Rooms on April 2nd, Mr. H. W. Roberts (London sales manager) presiding. The toast of "The G.E.C." was proposed by the chairman and responded to by Mr. J. Y. Fletcher, while that of "The G.E.C. Travellers" was proposed by Mr. L. C. Gamage, and responded to by Mr. E. A. Joyce. The chairman read telegrams from Sir Hugo Hirst and Mr. M. Railing wishing the gathering an enjoyable evening. Subsequently Messrs. Clapham and Dwyer, the V.H.S. trio, and other artistes provided an excellent musical programme.

Hydro-Electric Development in Switzerland.

According to a report recently issued by the Water Utilisation Department of the Swiss Government, there were 6,015 hydro-electric power stations in operation in Switzerland and eight in course of construction at the commencement of the present year, representing a total capacity of 2,653,000 h.p. Although the number of power stations shows a decline of about 12 per cent. as compared with 1914, owing to the closing down of a number of small plants, the capacity has increased threefold within the past thirteen years.

Prices of Raw Materials.

The following prices are only general, and they may vary according to quantities and other circumstances:—

	CHEMICALS, &c.		Price April 17th.	Fortnight's inc. or dec.
a	Acid, Oxalic	per lb.	5¾d.	...
a	Ammoniac, Sal	per ton.	£60	...
a	Ammonia, Muriate (large crystal)	,,	£32	...
a	Bisulphide of Carbon	,,	...	...
a	Borax	,,	£26	...
a	Copper Sulphate	,,	£25 10s.	...
a	Potash, Chlorate	per lb.	9½d. to 4d.	...
a	,, Perchlorate	,,	5½d.	...
a	Shellac	per cwt.	£18 10s.	...
a	Sulphur, Commercial	,,	£11	...
a	,, Roll	,,	£11	...
a	Soda, Chlorate	per lb.	3d.	...
a	,, Crystals	per ton.	£5 to £5 5s.	...
a	Sodium Bichromate, casks ...	per lb.	3½d.	...
	METALS, &c.			
b	Aluminium, Ingots	per ton.	£105 to £112	...
b	,, Wire	per lb.	1/9 to 1/9	...
b	,, Sheet	,,	1/8 to 2/9	...
p	Babbitts Metal and Anti-friction Metal—			
	Grade I	per ton net.	£209	£9 dec.
	Grade II	,, ,,	£145	£6 dec.
	Grade III	,, ,,	£77	£2 dec.
c	Brass (rolled metal 2" to 12" basis)	per lb.	9¾d.	...
c	,, Tubes (solid drawn)	,,	11¾d. to 1/-	...
c	,, Wire, basis	,,	9¾d.	...
c	Copper Tubes (solid drawn) ...	,,	1/1	...
c	,, Bars (best selected) ...	per ton.	£99	...
c	,, Sheet	,,	£94	...
c	,, Rod	,,	£99	...
d	,, (Electrolytic) Bars ...	,,	£67	...
d	,, ,, Sheets ...	,,	£148 10s.	...
d	,, ,, Wire Rods	,,	£77	...
d	,, ,, H.C. Wire	per lb.	9¾d.	...
f	Ebonite Rod	,,	2/8 to 2/6	...
f	,, Sheet	,,	2/8 to 2/6	...
n	German Silver Wire	,,	2/2	...
h	Gutta-percha, fine	,,	6/8	...
h	India rubber, Para fine	,,	10d.	2½d. dec.
l	Iron Pig (Cleveland No. 3.) ...	per ton.	65/-	...
l	,, Wire, galv. No. 8, P.O. qual.	,,	£21	...
g	Lead, English pig	,,	£21 10s.	...
g	Mercury	per bot.	£22 5s. to £22 10s.	...
e	Mica (in original cases) small ...	per lb.	3d. to 3/-	...
e	,, ,, medium	,,	4/- to 8/-	...
e	,, ,, large ...	,,	10/- to 20/- & up	...
p	Phosphor Bronze, plane castings	,,	1/9½	...
p	,, ,, drawn bars & rods	,,	1/8	...
p	,, ,, rolled strip & sheet	,,	1/2½	...
p	,, ,, wire...	,,	1/8½	...
e	Platinum	per oz.	£17 15s.	...
d	Silicium Bronze Wire	per lb.	10½d.	...
r	Steel, Magnet, in bars	,,	7½d.	...
n	Tin, Block (English)	per ton.	£235 10s. to £236 10s.	£5 10s. dec.
n	,, Wire, Nos. 1 to 16	per lb.	3/0	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

In their lead market report, dated April 14th, Messrs. James Forster & Co. state:—"There is still no evidence of any increase in demand in this country, while the same conditions prevail in Germany. On the other hand, offers from the United States are limited owing to the firmer tone there. The future is obscure. A better demand here or on the Continent would certainly result in an advance in prices. On the other hand, should the tone in the United States weaken, with no improvement here, the tendency would be for prices to decline."

Lighting and Power Notes.

Argentina.—ELECTRICAL DEVELOPMENT.—According to the *Review of the River Plate*, the Compania de Electricidad de la Provincia de Buenos Aires, Ltd., recently opened an important new power station in the zone of the Port of Mar del Plata. The plant at present installed consists of three 935-b.p. Carels Diesel engines. The erection of two similar engines is proceeding, and it is expected to have them in service for the summer season 1928-29. The station is designed for five Diesel sets and four steam turbines of 6,000 kWh each, or a total capacity of 27,000 kW, and the general scheme aims at replacing the five Diesel engines by the same number of steam turbines when the development of Mar del Plata justifies it, the capacity increasing thus from 27,000 kW to 54,000 kW. The total cost of the complete station with five Diesel sets is estimated at about $1,700,000.

Ashbourne (Derbyshire).—ELECTRICITY SUPPLY.—The Rural District Council has agreed to support the Urban District Council's application for authority to supply electricity in Ashbourne and six neighbouring parishes. The Derbyshire and Nottinghamshire Electric Power Company has asked the Rural Council to endorse an application to supply twenty parishes, and the Council has consented on condition that additional parishes are included.

Barnoldswick.—LOAN.—The Urban District Council is applying for sanction to borrow £12,500 for a proposed electricity scheme. The tender of Nelson Corporation for a bulk supply of electricity has been accepted.

Blackburn.—NEW COOLING TOWERS.—The Electricity Committee has approved a scheme submitted by the borough electrical engineer for the erection of two water cooling towers at an estimated cost of £9,700, and, subject to the Finance Committee sanctioning the expenditure, is to obtain tenders for carrying out the work.

LOAN.—The Committee has recommended that application be made for sanction to borrow £60,000 for further expenditure on mains, services and sub-stations.

Blackpool.—LOANS.—The Corporation proposes to apply for sanction to the following loans: Phase and frequency changer, £8,000; meters, £9,500; motor convertor and accessories, £8,000; extension of electricity supply to Poulton, Carleton and Marton, £48,000.

Brighton.—INSTITUTION SUPPLY.—The Corporation has received sanction to borrow £3,728 in connection with the electric lighting, &c., of the mental hospital.

Carlisle.—ELECTRICITY EXTENSIONS.—The expenditure of £95,000 on plant extensions at the electricity works is proposed by the Corporation Electricity Committee, to make provision to meet the development in consumption during the next ten years. The Corporation recently erected a new generating station, at a cost of £262,333, and the large expenditure now proposed is principally to meet the demands on the undertaking that are expected to follow the extension of the area of supply. The area will include many of the small towns and villages in the neighbourhood.

Chichester.—CHANGE-OVER.—The Town Council is to proceed with the change-over from d.c. to a.c. in the area comprising Whyke, Stockbridge, and South Street (east side), at an estimated cost of £3,000.

China.—SHANGHAI.—The total number of kWh sold by the Shanghai Municipal Electricity Department during the year 1927 was 400,343,385. The capacity of the plant is 121,000 kW.

Continental.—CZECHO-SLOVAKIA.—Plans are in progress for the erection of a 100,000-V transmission system to connect up all the large steam and hydro-electric power stations in Czecho-Slovakia. A line, about 53 miles in length, has already been completed between Seestadtl and Prague, while work is in progress on the erection of one 50 miles in length between Mahrisch Ostrau and Sillein.

GERMANY.—The Wurtemburg Provincial Electricity Supply Co. is engaged on the erection of a 100-kV transmission line between Oberturkheim, near Stuttgart, and Pforzheim, which will connect up the power stations in Baden and Bavaria across Wurtemburg. In this way a total of 600,000 kW will be available in the three provinces over a distance of 1,000 miles. In connection with the new transmission line the capacity of the transformer station at Unterturkheim is to be extended from 35,000 to 65,000 kVA.

SWITZERLAND.—Work has lately been commenced on the construction on the River Rhine near Rheinfelden, on the borders of Switzerland and Germany, of what will be one of the largest hydro-electric stations in Europe. It is estimated to cost £2,400,000, and will eventually comprise four turbo-generators, capable of an output of 650 million kWh per year. Contracts have been placed for the first three turbines. These are to be of the Kaplan type, and of 39,500 h.p. each, working at 75 r.p.m. under a net head of about 39 ft. The running wheels of the turbines will have an outside diameter of nearly 23 ft., while the leading-in blades will be 8 ft. 6 in. high.

BELGIUM.—The Société Generale Belge de Production d'Electricité "Interescaut," of Antwerp, has completed plans for the erection of a large central power station at Schelle at the confluence of the rivers Rupel and Scheldt. In order to meet the increasing demand for power supply, pending the completion of the Schelle station, the capacity of the plant at the Merxem station is to be increased by the replacement of an old 3,000-kW generating set by one of 12,500-kW capacity.

Doncaster.—CONTRIBUTION TO RATES.—The Corporation has allocated £2,500 from the profits of the electricity undertaking to the relief of the rates.

Dumfries.—ELECTRICITY SUPPLY.—The Town Council has decided to extend the mains and to provide the necessary incidental plant, at an estimated cost of £3,000, in order to give a supply of electricity to Troqueer Mills.

East Ham.—LOAN SANCTIONED.—The Town Council has received sanction to a loan of £4,869 for an additional convertor and switchgear in connection with a bulk supply from West Ham.

Glasgow.—OVERHEAD LINES.—A conference of representatives of various Corporation Committees interested in the proposal of the Central Electricity Board for the erection of main transmission lines took place in Glasgow on April 10th. The Board seeks permission to erect overhead lines suspended from steel masts or towers at a minimum height of 22 ft. from the ground for the transmission of electricity at a pressure of 132,000 V, for the purpose of connecting Dalmarnock, Port-Dundas, and Yoker power stations on a route which would interfere as little as possible with the amenities of the city. The Board's proposals were generally approved.

Gravesend.—ELECTRICITY SUPPLY.—In order to extend the supply of electricity in the Perry Street district, the Corporation Electricity Committee has decided to lay cables and erect two transformer kiosks, at a cost of £4,685.

Japan.—ELECTRICAL DEVELOPMENT.—The Niigata Denki K.K. has been granted a concession for the erection of a power station with a capacity of 20,200 h.p. on the Shinano river. The cost is estimated at 5,500,000 yen.

The South Manchurian Railway Co. is to commence manufacturing nitrogenous manure, and is to erect a power station in North Korea, at a cost of 10,000,000 yen.

The Hiroshima Electric Co. proposes to erect a power station of 20,000 kW in Kure, and work will commence shortly.

The Communication Department reports that during 1927 the capacity of generating plant increased by 490,000 kW, of which hydro-electric power stations were responsible for 220,000 kW and steam power stations 270,000 kW. During the current year the increase is estimated at 230,000 kW for hydro-electric power, and 110,000 kW for steam power.

London.—LEWISHAM.—The Housing Committee of the Borough Council has considered the question of the lighting arrangements for the houses and flats in the third section of the Grove Park housing scheme, offers for which have been made by the South Metropolitan Gas Co. and the South Metropolitan Electric Light and Power Co. The houses in the second section are lighted by electricity, and the Committee considers that the same illuminant should be used in the third section. The Electric Light Co. states that it is prepared to install the houses throughout for electric lighting and one point for heating, &c., free of cost to the Council, on precisely the same lines as in the earlier section, and will undertake the maintenance of the installation, excluding lamps and shades. As a result of the experience gained with the second section, the company is able to modify the rate to be charged to cover the special installation expenditure from 8¼d. to 8d. per kWh, and is agreeable to applying this revised rate to the houses comprising the second section of the estate. The Committee considers that the offer of the Electric Light Company should be accepted.

Mexico.—HYDRO-ELECTRIC DEVELOPMENT.—According to *The Times Trade and Engineering Supplement*, hydro-electric and irrigation works on the River Lerma, to the value of £180,000, are to be undertaken by the Cia. Constructora de Obras Hidro-electricas S.A. The power plant to be constructed will be of 60,000 h.p. capacity. Over 100,000 acres of land in the district of Acambaro will be irrigated. In connection with this work the National Railways of Mexico have constructed a branch of 13 km., from the Agua Buena station on the Mexico-Toluca-Acambaro line to Tepuxtepec. A h.p. line, 25 km. in length, from El Oro to Tepuxtepec, has been constructed. This line will furnish power for the work, and afterwards will transmit to Mexico City the power to be developed.

New Zealand.—ELECTRICAL DEVELOPMENT.—The Wellington correspondent of *The Times Trade and Engineering Supplement* reports that the use of electricity for farming, manufacturing, and domestic purposes is rapidly extending, and 90 per cent. of the population now has electricity at its disposal. Demand is well ahead of supply, especially in the Auckland district, where business is awaiting the completion of the Arapuni installation. Of the electricity supplied for all purposes, 74½ per cent. is generated by hydro-electric power stations, 23¼ per cent. by steam power stations, and the remainder

by oil and gas. Already the Government has expended £6,500,000, and local authorities connected with Government schemes £7,950,000 on hydro-electric schemes, and, in addition, other authorities have spent £3,050,000 on their plants.

Northern Ireland.—BANGOR (Co. DOWN).—The Town Council has appointed Mr. J. E. Sayers, of Glasgow, as a consultant to report on the question of an electricity supply for the town.

Penmaenmawr.—LOANS SANCTIONED.—The Urban District Council has obtained sanction to borrow £1,500 for the wiring of consumers' premises, £800 for meters, and £1,500 for mains and services.

Peterhead.—ELECTRICITY SUPPLY.—The Electric Supply Corporation, Ltd., has agreed to the terms of the Town Council for the laying of electric cables, and the work will be proceeded with at once.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

ISLINGTON.—Lighting: Flat rate of 3½d. per kWh. Power, heating and cooking: Flat rate of 1d. per kWh. These charges reduce the price of electricity to the rates which prevailed prior to the war.

EAST HAM.—Ordinary lighting: First 250 kWh per quarter, 5d. per kWh; beyond, 4½d. per kWh. Maximum demand rate: 8d. per kWh of the maximum demand for one hour per day for 92 days per quarter, and 3d. per kWh in excess. Domestic tariff for lighting, heating, cooking, &c.: A fixed quarterly charge, plus 8/10d. per kWh. Sign and outside lighting: 4½d. per kWh. Power: Varying from 3d. per kWh for the first 250 kWh per quarter to 1½d. for over 10,000 kWh. Heating, separate meter: 1½d. per kWh.

GUILDFORD.—Lighting: First 500 kWh per quarter, from 6¾d. to 6d. per kWh; beyond, from 3¾d. to 3d. per kWh. Heating, cooking, and domestic purposes: From 2¼d. to 1d. per kWh. Power: First 500 kWh per quarter, from 2¼d. to 2d. per kWh; beyond, from 1¾d. to 1½d. per kWh. Prepayment meters: From 1s. to 8d. per kWh. Theatres and kinemas: First 100 kWh per week, from 3¾d. to 3d.; beyond, 2d. per kWh. Industrial supplies by contract: From 1¾d. to 1½d. per kWh.

GILLINGHAM (KENT).—Power: Ordinary consumers, sliding scale—first 100 kWh per h.p. per quarter, 3d. per kWh, next 100 kWh, 2¼d., beyond, 2d.; guarantee of 500 kWh per h.p. per annum, 2d. per kWh.

ECCLES.—Private lighting: 4d. per kWh. Public lighting: 1½d. per kWh. Power: 3d. and ¾d. per kWh.

STRETFORD.—Lighting: From 4¾d. to 4½d. per kWh. Power: The war advance from 40 to 30 per cent.

STOCKTON-ON-TEES.—Lighting: First 1,000 kWh, 4d. per kWh; beyond, 3½d. per kWh. Heating: 1½d. per kWh. Power: First 1,000 kWh, 2d. per kWh; next 9,000 kWh, 1½d.; beyond, 1¼d. per kWh. A discount of 5 per cent. is made for prompt payment of accounts.

SALE.—Lighting: Flat rate of 4d. per kWh. Maximum demand system: 7d. and 1d. per kWh. Lighting, power, heating, &c., in private houses on the ratable value system: A fixed annual charge of 20 per cent. of the ratable value, plus ½d. per kWh. Domestic heating: First 100 kWh per quarter, 2d. per kWh; next 100 kWh, 1½d.; beyond, ¾d.

WINCHESTER.—Lighting: From 7½d. to 7d. per kWh.

OXFORD.—*Oxford Electric Co., Ltd.*—Lighting: Within the city, from 10d. to 7½d. per kWh; outside the city, from 11d. to 7½d. per kWh.

EALING.—Lighting: From 6d. to 5½d. per kWh.

BATH.—Lighting: 6d. per kWh for the first 1,500 kWh per quarter, and 5d. beyond. Heating and cooking: 1½d. per kWh. Two rate tariff: All electricity used between 4 p.m. and 10 p.m. at lighting rate, and 3d. per kWh during all other hours. Ratable value system: A standing charge, plus 1d. per kWh. Housing estates: Standing charge reduced from 11d. to 10d. per week.

Reigate.—CORRECTION.—We are informed by Mr. W. S. Ross, borough electrical engineer, that the revised electricity charges given in our last issue were incorrect. The following are the new charges:—Lighting: 6d per kWh. Heating: 2d. per kWh. Commercial power, 1½d. per kWh. Cooking: 1½d. per kWh with a charge for heating reduced to 1½d. where an electric cooker is in use.

Southport.—LOAN.—The Town Council has applied for sanction to a loan of £14,000 for a new water-tube boiler, with induced draught fan and auxiliaries.

Special Orders.—Applications have been made to the Electricity Commissioners for Special Orders by the Lynmouth Electric Light Co., Ltd., authorising it to supply electricity in the urban district of Lynton, and part of the rural district of Barnstaple; Burnley Corporation, authorising it to supply electricity in the township of Briercliffe; and the Electricity Company of Macclesfield, Ltd., to supply electricity in the urban district of Bollington, and part of the rural district of Macclesfield.

The Commissioners have submitted to the Minister of Transport for confirmation a Special Order made by them authorising the Chirk Electricity Supply Co., Ltd., to supply electricity in parts of the rural districts of Chirk and Oswestry.

Stretford.—SUB-STATION EXTENSION.—The Urban District Council Electricity Committee is to extend the automatic sub-station by the installation of a further 500-kW set, at an estimated cost of £4,250.

The Committee has decided to erect a sub-station at Urmston, at an estimated cost of £2,000.

Sunderland.—LOAN SANCTIONED.—The Corporation has received sanction to the borrowing of £37,730 in respect of the cost of the installation of new boilers, plant, &c., at the generating station.

NEW SUB-STATION.—The Corporation has decided to spend £8,474 on new sub-station buildings and equipment, including an additional transformer and switchgear.

Swansea.—ELECTRICITY SUPPLY.—The Corporation Electricity Committee has decided to proceed with the erection of three sub-stations at Sketty, St. Helens, and Brynmill, together with extensions of mains, at a total estimated cost of £11,981.

Taunton.—LOAN.—A recommendation by the Electricity Committee that application be made for sanction to borrow £17,200 for the provision of mains, services, meters, &c., came before the Town Council on April 10th. The chairman of the Committee said the Council had considerably extended its service area, and had connected a large number of manufacturing concerns for power. There was also a considerable increase in the use of electricity for cooking and heating. The kWh generated during the past year showed an increase of 360,000 over the previous year, or 15 per cent. The Council adopted the Committee's recommendation.

Tonbridge.—EXTENSION OF SUPPLY.—The Urban District Council has applied for a Fringe Order to supply electricity to Hadlow, Shipbourne, and Capel. The cost of distributing mains and h.p. mains is estimated at £11,550, and the estimated income for the first three years is £3,558.

Torquay.—STREET LIGHTING.—It was reported at a recent meeting of the Torquay Corporation Electricity Committee that a further 49 public gas lamps had been converted to electric lighting, leaving 481 gas lamps still to be converted. The cost of conversion with automatic switch control in 170 cases and the balance with hand control would be £8,080. In view of heavy capital commitments and the recent reduction of 10 per cent. in the charge for public lighting, the Committee came to the conclusion that it could not entertain the scheme for the conversion of the remaining gas lamps, except by a gradual process.

SEAFRONT ILLUMINATION.—A seafront illumination scheme has been sanctioned by the Town Council. The whole of the cliff face will be flood-lighted by means of forty high-power projectors, and altogether 2,000 feet of illumination will be required. The scheme is to be carried out in three sections, the first to be completed ready for the opening of the summer season, at a cost not exceeding £1,000 for the initial instalment. The full scheme will involve an expenditure of approximately £3,000.

Wareham.—OPPOSITION TO ORDER.—The Town Council has decided to oppose the application of the Bournemouth and Poole Electricity Supply Co., Ltd., for a Special Order to supply electricity in the borough.

Watford.—POWER STATION EXTENSION.—The Corporation Electricity Committee has received the sanction of the Electricity Commissioners to the extension of the power station.

Weymouth.—LOAN SANCTIONED.—The Corporation Electricity Committee has received sanction to a loan of £42,462 for plant extensions.

Tramway and Railway Notes.

Continental.—FRANCE.—A railless-car service has recently been put in operation by the Compagnie Générale Française des Tramways between Aubagne and Gemenos as an extension of the electric tramway between Marseilles and Aubagne. The vehicles, which are of the "Vetra" type, have accommodation for 40 passengers.

SPAIN.—Plans have been prepared for the construction of an outer circle electric railway round Madrid. The line would be nearly 40 miles in length, while there would also be branches extending to 20 miles.

Japan.—NEW ELECTRIC RAILWAYS.—A meeting of projectors of the proposed Japan Electric Railway Co. was recently held in Tokio. The proposed company is to construct an electric railway between Tokio and Osaka, and it is intended to complete the building of the railway in five years. The railway will start at Shibuya, Tokio, and end at Noye-machi, Higashi-Nari-ku, Osaka, covering a distance of 298 miles, on which rapid transit cars will be run, and there will be eight intermediate stations. The trains will be formed of five or six cars in ordinary times, and will run at a speed of about 50 miles, covering the whole distance in about six hours. The

electrical system will be 3,000 V d.c., and 10 sub-stations will be erected, which will receive supplies from various power companies.

An investigation recently made by the T.G.R. shows that there are 89 electric tramways, with a total mileage of 1,174, and 76 local electric railways, with a total mileage of 772, in operation in Japan. These are in addition to 27 railways totalling 570 miles, on which both steam and electric traction are in operation.

London.—BREAKDOWN.—Shortly after 11 p.m. on April 12th, a breakdown, which lasted half an hour, occurred on the L.C.C. tramway system and affected the whole service on the south side of the Thames and in other areas. The cause was a failure at Greenwich power station.

Stretford.—EXTENSION OF TIME.—The Urban District Council is making application to the Ministry of Transport for an extension of time for a further period of one year from June 15th, 1928, for the construction of the light railways authorised by the Stretford Light Railways Order, 1906, and Railway No. 10 of the West Manchester Light Railways (New Lines, &c.) Order, 1906.

Sunderland.—REMOVAL OF TRACK.—In view of the success of a 'bus service which replaced the tramway service two months ago, the Corporation has decided to take up the rails and remove the overhead equipment on the Docks route, subject to the Ministry of Transport's approval, at an estimated cost of £3,235, to be borne out of reserve fund.

Telegraph and Telephone Notes.

Australia.—INTERNAL RADIO COMMUNICATION.—According to the deputy director of the Postmaster-General's Department (Mr. G. G. Haldane), the research staff of the Department is investigating a scheme to establish a three-channel wireless service between Victoria and Tasmania. If possible, one channel will be used for telephone communication, and the other two for telegraph service. According to the *Sydney Morning Herald* the scheme would cost £50,000.

"BEAM" RADIO-TELEGRAPHY.—The cable and wireless telegraph traffic between Australia and the United Kingdom from April, 1927, to January, 1928, covering nine months after the "beam" system was started, totalled 11,740,000 words, of which the "beam's" share was 5,723,000, that of the Pacific cable 2,672,000, and of the Eastern Telegraph Company 3,345,000. The cables thus have the advantage of 294,000 words, says the *Daily Telegraph*. The "beam's" percentage was 49 over all, but the traffic varied as follows in proportion in the different classes: full rate 29, deferred 40, Government 19, Press 42, deferred Press 62, week-end 63, daily letter 65. The cables thus retain the greater proportion of the more profitable commercial traffic.

Belgium.—RADIO COMMUNICATION.—Because Belgians are divided into two clans, Flemings and Walloons, each of which insists on its right to employ its own language, Flemish and French, the Government wireless stations dealing with long-distance commercial traffic, mainly with America, may have to close down temporarily, says the *Daily Mail*. The transmitting post is at Ruysselede, near Ghent, and the receiving station at Liedekerke, near Brussels. These villages are both in Flanders and according to the provisions of the Language Law, the wireless operators employed there must be able to speak Flemish. At the last Government examinations no Fleming was successful in obtaining his radio-telegraphist's certificate, so it was proposed to fill the vacant posts with qualified non-Flemish-speaking Walloons; but the administration could not agree because such a course would infringe the terms of the law. The director of the wireless service has therefore had to reply that the only alternative is to close the stations until Flemish specialists are available.

Hungary.—AUTOMATIC TELEPHONY.—The conversion of the Budapest telephone service to automatic working began on April 15th, when 2,500 subscribers were to be transferred. By the end of June, 85,000 telephones will have been adapted to automatic working, and the change over of the whole of the Budapest service will be completed in the next year or two.—*Reuter* (Budapest).

Spain.—NEW RADIO-TELEGRAPH STATION.—Work has recently been commenced near Madrid on the erection of a new wireless-telegraph station, which the Sociedad Argentina is establishing to provide a direct service between Spain and the South Amerian Republics. The station is being designed for the simultaneous transmission of one telephone and two telegraph messages.

The Telephone Service.—AUTOMATIC SERVICE IN CHATHAM.—Another telephone area in England has been changed to automatic working, Chatham's system having been brought into use on March 31st last. The new exchanges comprising the area are Chatham (1,250 lines) with four satellites, *viz.*, Gillingham (530 lines), Strood (300 lines), Rochester (140 lines), and Snodland (190 lines). They provide a full automatic service for the area and were made and installed by Siemens Brothers & Co., Ltd., Woolwich, the equipment being of their No. 16 type.

Transatlantic Telephony.—CANADIAN SERVICE.—There has been a further extension of the Transatlantic telephone service in Canada, and it is now available in 37 towns in Canada, the most westerly being Vancouver. The service between Belgium, France, Germany, Holland and Sweden on the one hand and the United States and Cuba on the other has been extended to all the available places in Canada. The calls pass through the London trunk exchange, and the Rugby radio station.

Radio Notes.

Austria.—NEW STATION.—Next week the new 60-kW Rosenhügel station will be ready for steady work, says *World-Radio*, using 517.2 metres as its wave-length. The new station has been erected without disturbing the existing plant, which is going to Graz.

Canada.—NATIONAL BROADCASTING.—It was announced in the House of Commons on April 12th that in view of the increasing complications caused by independent broadcasting the Government was considering the question of adopting national broadcasting along the lines which are in force in Great Britain.—*Reuter* (Ottawa).

South Africa.—NEW TRANSMITTER.—It is reported from Johannesburg that part of the plant for the erection of a new station has arrived in accordance with the plan formed when the African Broadcasting Corporation took over the present station. The new set will feed 15 kW into the aerial and provide much better broadcasting for the Rand, Pretoria, and the rural district. The present JB set will probably be removed to Bloemfontein.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Aberdeen.—Parish Council. Re-wiring of the Council Chambers, 20, Union Terrace. Specifications from Mr. Harbourne Maclennan, architect, 16, Bridge Street, Aberdeen.

Acton.—April 30th. Town Council. Switchboard for the Public Bath. (April 13th.)

Australia.—MELBOURNE.—May 9th. Victorian Railways. 100 2,200-V oil switches. (B.X. 4343.)* Circuit controllers for point lay-outs. (B.X. 4344.)*

September 3rd. State Electricity Commission of Victoria. 120,000-V switchgear for Richmond terminal station; 135,000-V switchgear for Yallourn power station extension. (See this issue.)

Barking.—May 15th. County of London Electric Supply Co., Ltd. Installation of electric lighting at the Barking power station extensions. (April 13th.)

Bexhill.—April 27th. Electricity Department. L.p. 3-core, paper-insulated, lead-covered and armoured cables, 100 fluted cast-iron street lamp columns, 200 c.i. service boxes. (See this issue.)

Blackburn.—May 7th. Electricity Department. Two duplex natural draught cooling towers, each 500,000 gallons per hour capacity. (See this issue.)

Carlisle.—Electricity Department. L.c. and l.c.a. paper-insulated l.p. and h.p. cables. (April 13th.)

Colombia.—BOGOTA.—June 15th. Ministry of Posts and Telegraphs. 5,750 km. of telegraph line. (B.X. 4334.)*

Dundee.—April 27th. Electricity Department. D.c. and a.c. house service meters. (April 13th.)

Town Council. Electric lighting installation at new cleansing depôt, Fairfield Road. Particulars from Mr. George Baxter, 91, Commercial Street.

Dunfermline.—April 26th. Managers of Dunfermline and West Fife Hospital. Electrical installation in new laundry block. Specifications, &c (one guinea deposit), from Mr. Robert M. Connell, joint hon. secretary, Dunfermline.

Edinburgh.—May 7th. Electricity Department. Plant for the Portobello generating station. Four steam generating units, &c., evaporation 65/80,000 lb. per hour. Eight mechanical stokers with driving gear, suspended arches, ash hoppers, &c. Specification, &c., from Mr. Edwin Seddon, engineer and manager (deposit of £2 2s.).

Fort William.—April 24th. North British Aluminium Co., Ltd. Structural steelwork for power house, &c., for the Lochaber water power scheme. Specifications from the company's offices, Adelaide House, E.C.4.

Glasgow.—June 4th. Trustees of the Clyde Navigation. Electric cantilever crane of 175 tons, 150 tons, and 130 tons lifting capacity, for Glasgow Harbour. Specifications and forms of tender from Mr. Daniel Fife, mechanical engineer, 16, Robertson Street, Glasgow (three guineas deposit).

Grimsby.—May 1st. Electricity Department. Boiler plant. (April 13th.)

Harrogate.—April 28th. Electricity Department. E.h.p., h.p., and l.p. switchgear, transformers, service meters, and service cut-outs. (April 13th.)

Hull.—June 25th. Telephone Committee. One automatic telephone exchange (4,000 lines). (April 6th.)

India.—May 1st. India Store Department. Two Diesel locomotives for 5 ft. 6 in. gauge. Forms of tender (5s.) from the Store Department, Belvedere Road, S.E.1.

May 8th. 4,000 lb. silk covered copper wire. (See this issue.)

Inveresk.—April 25th. Board of Combination Poorhouse. Electric lighting installation. Specifications from Mr J. B. Anderson Begg, consulting engineer, 8, Hope Street, Edinburgh (one guinea).

London.—H.M. OFFICE OF WORKS.—April 24th. Mechanical and electrical engineering labour in daywork in the Newcastle-on-Tyne, Leeds, and Southampton districts. (April 13th.)

BETHNAL GREEN.—April 24th. Board of Guardians. Extension of the internal telephone system at the Institution, Waterloo Road. (April 13th.)

ST. PANCRAS.- May 11th Electricity Department. Two 1,000-kW and three 2,500-kW motor convertors. (See this issue.)

ST. MARYLEBONE.—May 2nd. Electricity Department. 12 months' supplies of l.p. and e.h.p. underground cables. (See this issue.)

Manchester.—May 2nd. Electricity Committee. Twelve months' supply of meters, cable, electric kettles, and potential and current transformers. (April 13th.)

May 1st. Eight 250-kVA static transformers. (See this issue.)

Ripon.—May 19th. Electricity Department. E.h.p. and l.p. cables, boxes, roadwork and public lighting. (See this issue.)

South Africa.—JOHANNESBURG.—May 16th. Town Council. Switchgear and transformers. (B.X. 4284.)*

PRETORIA.—May 31st. Department of Posts and Telegraphs. Outdoor distribution boxes for 15-pair telephone cable and magneto and central battery switchboards. (B.X. 4324.)*

June 7th. Telephone cable, copper wire, &c. (B.X. 4335.)*

CAPE TOWN.—May 2nd. Municipal Council. 1,000 wrought-iron or mild steel tubular electric light poles. (A.X. 6157.)*

Southend-on-Sea.—April 30th. Corporation. One electrically-driven direct-coupled centrifugal pumping set for Eastern Valley pumping station. Specifications, &c. (£2), from Mr. R. H. Dyer, borough engineer and surveyor.

May 1st. Light Railways and Electricity Department. 1,500 current limiters. (April 13th.)

Stirling.—April 26th. Town Council. Electrical work in connection with the new police station. Specifications from Mr. Andrew H. Goudie, burgh engineer (deposit of £1).

Stoke-on-Trent.—May 9th. Electricity Department. One 12,500-kW turbo-alternator and condensing plant. (March 23rd.)

Stone.—May 8th. Urban District Council. E.h.p. overhead electric transmission line, &c (See this issue.)

Swindon.—May 5th. Electricity Department. H.p. feeder, l.p. pilot and other cables. (April 13th.)

Wigan.—April 25th. Board of Guardians. Electric light installation at institution. Mr. J. S. Liptrot, clerk, 9, Victoria Buildings King Street.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Birmingham.—Board of Guardians. Accepted:—
Installing electric lighting in the casual wards (£775); at Selly Oak Hospital (£491); and at Dudley Road Hospital (£128).—Reynolds & Bradwell.

Burton-on-Trent.—Electricity Committee. Accepted:—
200-kVA transformer (£171).—Metropolitan-Vickers Electrical Co., Ltd.

Bury.—Town Council. Accepted:—
Electrically-driven pump for filtration plant at baths.—Royles, Ltd.
Special trackwork.—Edgar Allen & Co., Ltd.
Travelling crane.—Herbert Morris, Ltd.

Carlisle.—Electricity Committee. Accepted:—
7,500-kW turbo-alternator set (£21,530).—British Thomson Houston Co., Ltd.
Boiler-house plant (£35,775).—Stirling Boiler Co., Ltd.
Condensing plant (£5,559).—Mirrlees, Watson Co., Ltd.

Chester.—Board of Guardians. Accepted:—
Electrical goods for six months.—G. P. Dennis, Ltd.

Chesterfield.—Electricity Committee. Accepted:—
Cable (£1,037).—Greenwich Cable Works, Ltd.
Automatic h.p. voltage regulator (£131).—Metropolitan-Vickers Electrical Co., Ltd.

Croydon.—Board of Guardians. Accepted:—
Electrical fittings and appliances for six months.—J. R. Lander.

Dartford.—Electricity Committee. Recommended:—
Three e.h.p. oil switches, fuses, bus-bar chambers, and truck cubicle (£455).—English Electric Co., Ltd.
Two 350-kVA transformers (£430).—Brush Electrical Engineering Co., Ltd.
Cable and switchgear (£2,775).—Johnson & Phillips, Ltd.

Douglas (Isle of Man).—Finance Committee. Recommended:—
Electric sign at Villa Marina (£126).—J. Akers, Ltd.

Dundee.—Housing Committee. Accepted:—
Electrical work at 20 flatted houses in Lochee (£108).—Artistic Decorations, Ltd., Dundee.

Glasgow.—Tramway Committee. Recommended:—
Copper bonds.—British Insulated Cables, Ltd.
Battery truck.—Herbert Morris, Ltd.
V.i.r. cable (£125).—General Cable Mfg. Co., Ltd.

Gas Committee. Recommended:—
Electric cable to booster house (£214).—Craigpark Electric Cable Co., Ltd.

Gravesend.—Electricity Committee. Recommended:—
Switchgear for new feeder to Henley's works (£303); five switch cubicles (£584).—British Thomson-Houston Co., Ltd.
440-kV rectifier equipment at Rosherville sub-station (£3,568).—Hewittic Electric Co., Ltd.

Hamilton.—Electric Lighting Committee. Accepted:—
Mains renewals (£3,895).—Metropolitan Electric Cable and Construction Co., Ltd.
The Town Council has approved the recommendation.

Hastings.—Electricity Committee. Recommended:—
De-aerating plant for Broomgrove power station.—Hick, Hargreaves & Co., Ltd.

Lamp Contracts.—The British Thomson-Houston Co., Ltd., Siemens Electric Lamps and Supplies, Ltd., the Edison Swan Electric Co., Ltd., and Metro-Vick Supplies, Ltd., have received 12-months' contracts for the supply of electric lamps from the North-Eastern Railway Co. The Port of London Authority has placed three-months' contracts for electric lamps with Siemens Electric Lamps and Supplies, Ltd., and Metro-Vick Supplies, Ltd.

Leeds.—Electricity Committee. Accepted —
Cable.—(£3,560), Macintosh Cable Co., Ltd.; (£2,144), W. T. Henley's Telegraph Works Co., Ltd.; (£1,616), Enfield Cable Works, Ltd.; and (£697), Greenwich Cable Works, Ltd.
Sub-station switchgear.—(£230), Yorkshire Switchgear and Engineering Co., Ltd.; and (£174), H. J. Fuller and Sons.
Meters for 12 months.—Measurement, Ltd.

Sewage Committee. Accepted:—
Electric power and lighting cables for High Level Works, Thorpe Stapleton (£743).—Wilson, Hartnell, Ltd.

London. — SHOREDITCH. — Lighting Committee. Recommended:—
Cable (£2,249).—W. T. Glover & Co., Ltd.

Manchester.—Water Committee. Accepted:—
Two electrically-driven centrifugal pumps.—Frank Pearn and Co., Ltd.

Education Committee. Accepted:—
Installation of electric lighting and cooker at Bengal Street domestic centre.—John Adams, Ltd.

Sheffield.—Tramways Committee. Accepted:—

25 tramcar trucks (£152 each).—Brush Electrical Engineering Co., Ltd.

1,000 tons of tram rails (£9 17s. 6d. per ton).—Steel, Peech and Tozer, Ltd.

25 double-deck top-covered vestibule tramcar bodies, erected complete on trucks (£1,190 each).—W. and E. Hill, Ltd.

25 car sets of tramcar upholstered seating (£157 10s. per set); 20 trucks, complete (£220 each); 5 trucks with roller bearings (£278 each); 25 sets of control and braking system (£205 per car set, erected); 25 sets of control and braking system, not erected (£182 per car set).—Cravens Railway and Carriage Co., Ltd.

50 rheostats (£10 15s. each).—Electro-Mechanical Brake Co., Ltd.

100 automatic circuit breakers (£10 10s. per pair).—Metropolitan-Vickers Electrical Co., Ltd.

25 sets B.M. & R. swivelling contact trolley standards (£16 17s. 6d. per car set).—Malleable Steel Castings Co., Ltd.

50 sets electric lighting fittings (£9 13s. 6d. per car set); 50 sets Faraday high-voltage car-signal system (£7 7s. per car set).—General Electric Co., Ltd.

100 tramcar controllers (£85 per pair); 25 traction-type lightning arrestors (£66).—British Thomson-Houston Co., Ltd.

Stretford.—Electricity Committee. Accepted:—
Thrust borer (£265).—Hydraulic Engineering Co., Ltd.

Watford.—Electricity Committee. Accepted:—
Two boilers (£11,488).—J. Thompson & Co., Ltd.

Wednesbury.—Staffs. Education Committee. Accepted: Remodelling the electrical installation at Wednesbury Technical College (£226); installation of electric lighting and power in the new wing (£564).—W. G. France (Darlaston).

West Bromwich.—Board of Guardians. Accepted:—
Installing electric lighting in the medical officer's and matron's quarters (£178).—Gordon Hughes Electrical Co.

Forthcoming Events.

Institution of Electrical Engineers (North-Eastern Centre).—Monday, April 23rd. Armstrong College, Newcastle-on-Tyne. 7 p.m. Annual general meeting. "Electrification of the Pietermaritzburg-Glencoe Section of the South African Railways." Mr. F. Lydall.

Friday, April 27th. 4.45. Visit to the Singapore Floating Dock at Wallsend. 7.30 p.m. War Memorial Hall, Wallsend. "Electrical Equipment of the Dock." Mr. E. T. Williams.

(London Students' Section).—Friday, April 27th. Institution, London, W.C. 6.15 p.m. Annual general meeting. "Super-Tension Cables." Mr. R. A. Brockbank.

(Scottish Centre).—Friday, April 27th. Foresters' Hall, Nicol Street, Dundee. 7.30 p.m. Faraday Lecture, "Electricity in the Service of Man." Dr. S. Z. de Ferranti, F.R.S.

(South-Midland Centre).—Wednesday, April 25th. University, Birmingham. 7 p.m. Kelvin Lecture, "Recent Advances in Physics." Sir Oliver Lodge, F.R.S.

Illuminating Engineering Society.—Tuesday, April 24th. Home Office Industrial Museum. "Daylight, Artificial Light, Artificial Daylight: their Merits and Drawbacks." Mr. J. S. Dow.

Electrical Power Engineers' Association (London Local Technical Group).—Wednesday, April 25th. Institution of Electrical Engineers, Victoria Embankment, W.C. 7 p.m. "The Testing of Super-Tension Cables." Mr. M. Martin Höchstädter.

Junior Institution of Engineers.—Thursday, April 26th. Monico Restaurant, Piccadilly Circus, W. 6.30 p.m. for 7 p.m. Annual dinner.

Friday, April 27th. 39, Victoria Street, S.W. 7.30 p.m. "The Manufacture of Structural Steel, &c." Mr. C. Hubert Plant.

Birmingham Electric Club.—Friday, April 27th. Grand Hotel. 7 p.m. "Modern Developments of Magnetting Machinery." Mr. W. Box.

Physical Society.—Friday, April 27th. Imperial College of Science, South Kensington, S.W. 5 p.m. Ordinary meeting.

Royal Institution of Great Britain.—Friday, April 27th. 21, Albemarle Street, W. 9 p.m. "Carriers of Electricity in the Atmosphere." Prof. A. M. Tyndall.

Notes.

Summer Time.

Summer time comes into force in this country at 2 a.m. on April 22nd; accordingly, all timepieces set to G.m.t. should be advanced one hour during the night of Saturday-Sunday next. Summer time began on April 14th in France, Belgium, Spain, and Portugal, but the change is not to be made in Holland until May 15th.

Electricity and Gas: Capital Expenditure.

In a review of the Electricity Commissioners' Return of engineering and financial statistics for 1925-26, appearing in the *Gas World*, it is mentioned that of electricity supply undertakers "local authorities have raised loans to the amount of £125,663,093, and companies loans and shares or stock amounting to £62 556,756, a total of £188,219,849. Local authorities have reduced their loan indebtedness by repayments or sinking fund balances by £48,684,813 so that the outstanding capital actually raised (companies and local authorities) is £139,525,036. For the same year the corresponding figure of outstanding capital for gas undertaking is as follows:—

Companies raised	£109,335,613
Local authorities do.	62,652,376
	£171,987,989
Less local authorities repaid	33,426,330
Net outstanding	£138,561,659

"Thus we see that for the first time capital commitments of electricity supply exceed that of gas supply. The actual difference is greater than the electrical figure of £139,525,036, and the gas figure of £138,561,659 imply, for the latter is inflated to some extent by capital conversions. We may anticipate that, with the large electrical expenditure which has occurred between the period to which the figures relate and to-day the difference will widen with electricity more heavily committed, and continue so in the immediate future with electricity so much prone to speculate in 'futures.'"

E.A.W. Activities.

The spring programme of the Electrical Association for Women concluded with a visit to the new showrooms of the Westminster Electric Supply Corporation, when a short talk on "The History of Electricity Supply in the Westminster District" was given by Mr. Milner.

The last of the evening lectures took place on March 27th, at the E.L.M.A. Lighting Service Bureau, when an excellent paper was given by Miss M. de Gruchy, of Croydon, on "Some Difficulties in Dealing with Consumers."

A special lecture demonstration on electric cooking was given for demonstrators on March 28th, in the model electric kitchen, 46, Kensington Court, by Miss Dorothy Vaughan.

On March 29th a party of members of the British Housewives Association, including Mrs. C. S. Peel and Miss Muncaster, visited the E.A.W. Model Electric Kitchen and Club Room, and Miss Vaughan again gave a lecture demonstration on electric cooking.

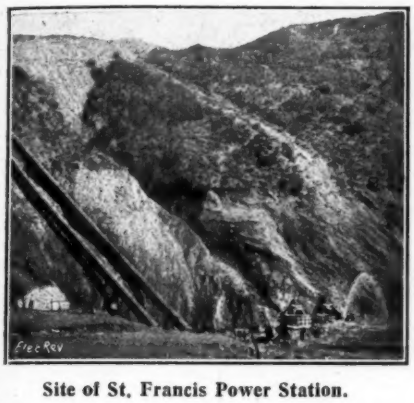
A visit was paid to the *Western Mail* printing works, Cardiff, on April 13th by members of the South Wales and Monmouthshire Branch of the Electrical Association for Women.

A Large High-Voltage Generator.

A new 60,000-kW turbo-generator set which has been added to the plant of the Buffalo General Electric Co., N.Y., has been designed to feed directly into the 22,000-V transmission system, and some particulars of the arrangement, which are given in an article by Mr. Cromwell MacIntosh, assistant electrical engineer to the company, in the *Electrical World*, are of interest. The generator operates in conjunction with a three-phase auto-transformer rated at 66.667 kVA, 12,000 to 22,500 V, 25 cycles. The "low-pressure" winding is solidly connected to the generator terminals and the high-pressure windings feed into the transmission line through circuit breakers and disconnecting switches. In order to keep the short-circuit strains on the system within the limits for which the equipment on the system was originally designed, the auto-transformer is designed with a special double-winding arrangement. Each phase has two parallel windings permanently connected together at the neutral and 12,000-V taps. One winding connects the line through 5 per cent. reactors, and the other through similar reactors and an oil circuit breaker. This "reactance breaker" is operated by instantaneous overload relays set to trip when the generator output exceeds 300 per cent. of its rated current. With both windings connected the auto-transformer has an impedance of 3.8 per cent. on 66,667 kVA, but when the reactance breaker trips, the impedance is changed to about 18 per cent. on the same capacity, and this large increase comes into circuit before any circuit breakers have tripped at the terminal station, with the exception of a bus-bar junction breaker which has ample rupturing capacity. When the "reactance breaker" opens, it leaves the generator synchronised with the load, and as soon as the initial disturbance has passed the operator at the generating station recloses the breaker.

Failure of Dam at Los Angeles.

The *Electrical World* of March 31st gives particulars of the disaster which took place on March 12th, when the St. Francis Dam of one of the power stations of the municipality of Los Angeles, in Southern California, broke down, releasing 38,000 acre-ft. of water, and creating a flood estimated at between 500,000 and 900,000 sec.-ft., which swept destructively through the valley below. The loss of life is estimated at 300 persons, and the damage to property will amount to approximately $25,000,000. One of the accompanying illustrations, reproduced from our contemporary, shows two 17,500-kW G.E.C. turbo-alternators, which were the only parts of the plant left after the waters had receded; one of them will probably be salvaged. Engineering testimony so far elicited points to the unstable character of the rock forming the foundation of the dam as the cause of the disaster. The dam, which was completed two years ago, was 75 ft. wide and 208 ft. high.



Site of St. Francis Power Station.

Centre portion of Dam, left standing.

After the flood had left the mouth of San Francisquito Canyon, it crossed two 220-kV lines of the Edison Company. Nine towers were torn down in the west line; this line was repaired and in operation three days after the flood. The east line, immediately adjacent to the west line, had three towers destroyed; this line was put back into operation on March 19th. A third 220-kV line was not affected; to provide for just such emergencies as existed during and after this flood, this line had been built over a new right-of-way entirely separate from the original two lines, and when they fell the load was immediately transferred to the Vincent line.

The Edison Company had 300 men on the ground before daybreak on March 13th, and had built a temporary line to serve two counties before business opened up in these communities.

On a mesa immediately adjacent to the Santa Clara River, down which the floodwaters raged, the company had a construction camp of 178 men. This camp was about 22 miles away from the dam. The floodwaters covered this table-land and destroyed the camp; ninety-four of the men escaped alive. The Edison Company's monetary loss will not exceed $100,000. That of city bureau property is now put at $5,000,000.

Electric Mining Locomotives in Sweden.

The Swedish General Electric Co. recently supplied a number of electric locomotives for underground operation in the mines of the Grangesberg Gemensamma Gruvforvaltning, Grangesberg, Sweden. They are in continuous operation, work being carried on in the mines in three 8-hour shifts per day; the normal train consists of a locomotive and 30 trucks, the train weight being 147 tons. The dimensions of the locomotives were limited by the fact that they had to be lowered down the mine shaft to a depth of about 600 ft. The motors are totally enclosed and ventilated by a closed-circuit cooling air sytem, the heated air from the motors being blown through a duct by means of a fan and through an air cooler placed above the locomotive frame next to the driving cab. The locomotives are equipped with two railway type motors, each developing 31 h.p. (23 kW) on one hour rating at 500 volts and 320 r.p.m.

Manchester Steam Users' Association.

In view of his imminent retirement from the position of chief engineer to the above Association, Mr. C. E. Stromeyer, in his memorandum for the year 1927, has summarised his views on possible improvements in boiler design. The following notes are taken from the report:—"The term elastic limit has been the cause of confusion which is ample justification for not adopting the elastic limit as a standard of comparison of safe stresses. Some confusion has also arisen as to what is meant by endurance limit. Having made a large number of fatigue tests, both torsion and bending, I not only established that there was an endurance limit, but also that the life of a specimen could be predicted with the help of the formula: plus and minus $s=E+C\ (10^6/n)^{\frac{1}{4}}$, where s is the stress which, repeated n times, will just cause fracture; E is the limit of endurance and C a constant. More will be gained by classifying materials not so much in accordance with their static tenacities and other properties, but in accordance with their fatigue properties. But there is another branch of the subject, as yet hardly touched upon, which is the combination of permanent and fatigue stresses. Wöhler, in 1874, made one set of experiments which indicates that if a permanent stress be added to fatigue stresses, then s, the half-range of these stresses, diminishes as the permanent stress increases. According to Wöhler's experiment the diminution is approximately a parabolic one, but static tests indicate that the diminution is not so rapid. There are many cases of boiler plates cracking after the pressure has been let down; in fact, boilers do not seem to crack mysteriously while under steam. Fatigue experiments have demonstrated that it is permissible to calculate the strengths of structures as if the material were plastic, for fatigue failures imply plasticity. But plastic strains imply stresses which are of fairly uniform intensity, so that the elaborate elastic formulæ may be dismissed. In a plastic plate the stresses round rivet holes are not three times as great as the average, as demonstrated by elastic theories, and we may deal simply with the average stress; and the maximum shearing stress in a rivet is not twice the average stress as per elastic theories, but is the average stress.

While experience might suggest that dished ends for boiler drums are dangerous and should either be abolished or strengthened, a close study suggests the opposite policy, the thinning of dished end plates. The Board of Trade remedy, which is not to sanction unstayed dished ends, is not engineering. When dished ends first came into fashion it was not realised that there were secondary stresses, which were not directly due to pressure, but due to deformations which the pressure produced in other parts of the boiler. Unfortunately, too, other considerations made it seem desirable to keep the depths of the dished ends as low as possible, and as a flattening of the dished end was believed to demand thicker plates, because of the sphere theory, the plan was adopted of giving very sharp curvatures to the roots of the flanges. Then one dished end after another exploded, and special searches for cracks in the roots of flanges revealed quite a number. At one power station we discovered 48 cracked dished ends amongst 64. A curiosity about this case, and about nine others which are still under supervision, is that the circumferential cracks in the roots of the flanges seem to have relieved the strains. This is so utterly contrary to elastic theories that the matter ought to be thoroughly investigated. Recent experiments in Germany have revealed that, by making the end plates conical instead of spherical, greater strength is attained; in fact, the conical shape is the natural one if a dished end be so severely stressed that it suffers a large permanent deformation."

Appointments Vacant.

Telegraph foremen (£400) for the Government of the Gold Coast. Deputy borough electrical engineer for the Borough of Bermondsey electricity undertaking (£700). E.h.p. plumber-jointer for the Barrow-in-Furness Electricity Department. (See our advertisement pages to-day.)

Fatality.

The Sydney *Daily Guardian* reports that Arthur Yelds, a gardener employed by Dr. A. H. Rutherford at his Point Piper home, recently received a fatal electric shock from an electrically-driven mowing machine. He was found on the tennis court, his right hand grasping two terminals. Two holes had been burnt in his hand.

South Wales Mining Electrical Engineers.

The South Wales branch of the Association of Mining Electrical Engineers held its sixth general meeting at the Treforest School of Mines on April 14th, when Major E. Ivor David presided, and an interesting lecture on "The Tungar Rectifier and its Mining Applications" was delivered by Mr. Arnold P. Hill, M.Eng. With the aid of lantern slides, the lecturer dealt very lucidly with his subject and classified the mining applications of the rectifier under various heads. A keen discussion followed, in which the respective merits of the rectifier and motor-generator were closely compared. Prior to the meeting the members, numbering close on a hundred, spent an interesting time in the laboratories of the school. The following officials and members of Council have been nominated to hold office during the coming session:—Branch president, Mr. T. S. Thomas, Bedwas; branch vice-presidents, Mr. W. W. Hannah, Tredegar, and Sir A. Whitten Brown, Swansea; hon. treasurer, Mr. A. C. MacWhirter, Cardiff; and hon. secretary, Mr. H. J. Norton, Cardiff.

Aeroplane and Overhead Lines.

According to the *Daily Telegraph*, on Friday last a Moth two-seater aeroplane belonging to the Norwich Air Club struck some overhead electric wires on Mousehold Heath, and, after turning a somersault, crashed. The pilot, Mr. F. C. Fry, who was thrown clear, was badly shaken, and the passenger, Mr. H. Birchall, received a compound fracture of the leg. Both were detained in hospital. When the machine struck the wires, which were about 30 ft. from the ground, there was a vivid flash. The wires and one of the poles were knocked down.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

The marriage took place at Nantwich, on April 9th, of Mr. G. T. Manley, A.M.I.E.E., of Willaston, Cheshire, and Miss Lily Hitchen.

On April 9th, Mr. Gifford Hallam, principal of J. E. Hallam & Sons, electrical engineers, of Stockport, was married to Miss Clarice Russell Hamlett, eldest daughter of Councillor W. Hamlett, of Stockport.

The marriage took place at Burslem, on April 3rd, of Mr. J. E. Macfarlane, A.M.I.E.E., of Taunton, and Miss Millicent Hulme, of Burslem.

Mr. Eric K. Richardson, of Farnworth, has been selected out of 105 applicants for the post of electrical engineer to the Tilbury U.D.C.

The Winchester City Council has appointed Mr. W. McD. Tait, mains engineer with the Worksop Urban Council, as assistant mains and consumers' engineer.

The Sheffield Corporation Finance Committee recommends that the salary of Mr. J. F. Colquhoun, lighting engineer, be increased from £500 to £550 per annum.

The committee in charge of Accrington's jubilee celebrations has recommended the Town Council to make the Mayor (Ald. T. E. Higham, J.P.) the first freeman of the borough. Alderman Higham is chairman of the Mid-Lancashire Electricity Advisory Board and chairman of the North-Western District Council (No. 3) for the Electricity Supply Industry.

Mr E. J. Jennings has retired from the office of hon. secretary and treasurer of the District Industrial Council for the Electricity Supply Industry (West Midlands Area), and on Monday, following the annual meeting, he was presented with a coffee service as an expression of appreciation of his services. He has held the office since the formation of the Council in 1919. The gift was made by Mr. R. F. Dempster, vice-chairman for the past year, who will be chairman during the ensuing 12 months; and Ald. A. G. Ellaway, the retiring chairman, also testified to Mr. Jennings's able and public-spirited service.

Mr. W. T. Hilder, M.I.E.E., has resigned his appointment of engineer and general manager of the Urban District Council of Aberdare Electricity and Tramways Department, in order to take up the appointment (on May 1st) of resident manager of the South Somerset and District Electricity Co., Ltd. (chief area office: Electricity House, Chard, Somerset).

Mr. F. Gill has been elected a vice-president in the International Telephone and Telegraph Corporation. He retains his position on the board of Standard Telephones and Cables, Ltd. Mr. G. Deakin has been appointed first assistant chief engineer in the International Corporation, but he retains his position on the board of Le Matériel Téléphonique, Paris. Mr. G. H. Nash, C.B.E., has been appointed European chief engineer in the International Standard Electric Corporation, and he retains his position on the board of Standard Telephones and Cables, Ltd Mr. P E. Erikson has been appointed assistant vice-president in the International Standard Electric Corporation, and Mr. E. S. Byng has been appointed European Director of Installation in the same Corporation.

Mr. James A. Gray, Dunfermline, has been appointed engineer-in-Charge to the Fort William Electric Light Supply Co., Ltd.

Sir Alexander Roger, chairman of the Automatic Telephone Manufacturing Co., Ltd., the International Automatic Telephone Co., Ltd., &c., and a director of British Insulated Cables, Ltd., &c., has accepted a seat on the board of the Alton Battery Co., Ltd. Mr. W. R. Montgomery, A.M.I.E.E., manager of the Alton Battery Co., Ltd., has also been elected to the board, which now consists of the above two gentlemen and the founder and chairman of the company, Mr. C. C. Rattey, M.I.E.E.

Mr. G. Cameron, mains superintendent at the electricity works of the Hazel Grove and Bramhall Urban Council, has resigned.

The *Irish Electrician* states that the following appointments have been made in connection with the Shannon power scheme to positions recently advertised by the Electricity Supply Board for their Design and Construction Department:—The senior engineers appointed are Messrs. Patrick Hoskins (late of the Brooklyn Edison Co., New York) and Fergus O'Kelly (late of McEntee & O'Kelly, consulting engineers, Dublin). Among the junior appointments are those of Patrick Byrne, Patrick Carr, R. G. Jackson, Kenneth McLaren, James Murphy, William O'Neill, William Rowe, Thomas Ryle, Lawrence Veale, and John Ware.

Bt. Lieut.-Col. N. Hudson, D.S.O., A.M.I.E.E., &c., is one of the members of the new Technical Sub-Committee of the Mechanical Warfare Board.

Obituary.—Mr. N. G. Kapp.—*The Times* of April 5th announced the death, on March 17th, of Mr. Norman Gisbert Kapp, younger son of the late Professor Gisbert Kapp.

Sir J. A. Kempe.—We are sure that a large number of our readers will desire to join with us in an expression of deep sympathy with Mr. Harry Robert Kempe, late electrician to the General Post Office, compiler of Kempe's Engineer's Year Book, and part-proprietor of the Electrical Review, on the occasion of the death of his brother, Sir John Arrow Kempe, K.C.B., aged 82 years, and more recently the loss of his nephew, Mr. Francis Bernard Kempe (grandson of the late Rev. Prebendary Kempe) at the age of 47 years.

Mr. J. Moffatt.—We regret to record the death of Mr. John (Jock) Moffatt, which occurred on April 4th. Mr. Moffatt, who had been with the Edison Swan Electric Co., Ltd., for over forty years, and for many years had represented that company as London traveller, will be greatly missed in the electrical trade. He had a very brief illness, and, indeed, attended the office on the day before his death.

Mr. C. E. Wetton.—It is with much regret that we have to announce the death of Mr. C. E. Wetton, which took place at Westcliff-on-Sea on April 5th at the age of 66 years. The deceased gentleman was for 25 years London manager to British Insulated Cables, Ltd. He retired in June last year, and since that time had suffered continued ill-health. The funeral service took place on April 10th at St. Albans, Westcliff-on-Sea, the interment following at Sutton Road Cemetery, Southend-on-Sea.

Will.—The late Mr. Michael Longridge left £22,901 gross and £22,772 net personalty.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Crowe & Company (Kinematograph Engineers), Ltd.—Private company. Registered April 12th. Capital, £3,000 in 1,000 7 per cent. cumulative preference and 2,000 ordinary shares of £1 each. Objects: To acquire the business of a kinematograph accessory supplier and kinematograph engineer carried on by Carter Crowe at 11, Bath Lane, Newcastle-on-Tyne, as Crowe & Company, and to carry on this and the business of electrical and general engineers, &c. The permanent directors are:—C. Crowe, "Dunowich," Pinewood Avenue, North Gosforth, Newcastle, kinematograph engineer (managing director); W. H. Bailey, 105, Harrington Road, Workington, kinema proprietor; M. H. Maud, address not stated. Secretary: H. J. Rigg, 22, Lowther Street, Carlisle.

Automatic Electrical Refrigerators, Ltd.—Private company. Registered April 11th. Capital, £5,000 in 4,985 6 per cent. cumulative preference shares of £1 each and 300 founders' shares of 1s. each. Objects: To carry on the business of manufacturers of automatic and other refrigerators, electrical engineers, &c. The first directors are:—C. C. Kline, 59, Bromham Road, Bedford, merchant; J. M. Maitland, 52, Goldington Avenue, Bedford, merchant; Mrs. Isabel M. Maitland, 52, Goldington Avenue, Bedford. Registered office: 47, High Street, Bedford.

W. J. Harris (Birmingham), Ltd.—Private company. Registered April 4th. Capital, £5,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in drawing and scientific instruments, mechanical, electrical and scientific apparatus, fittings, machines and accessories, and all articles made from metal turnings, stampings, pressings, &c. The first directors are:—F. G. Cook, manufacturer, and Mrs. A. M. Cook, both of 118, Albert Road, Handsworth, Birmingham. Secretary: F. Darlington. Registered office: 111 and 112, Whitmore Street, Birmingham.

Bolling & Lowe (1928), Ltd.—Private company. Registered April 7th. Capital, £5,000 in £1 shares. Objects:—To carry on the business of dealers, factors or agents in respect of iron, copper, steel and all other metals and metallic substances, mechanical and electrical engineers, &c. The first directors are:—A. M. Doughty, 63, Lancaster Gate, W.; G. C. Gardner, 43, Kenilworth Avenue, S.W.19. Registered office: 2, Laurence Pountney Hill, E.C.4.

Enarco, Ltd.—Private company. Registered in Edinburgh April 5th. Capital, £1,000 in £1 shares. Objects:—To carry on the business of dealers in, and agents for, labour-saving appliances, electrical and general merchandise, importers and exporters, &c. The directors are:—N. L. J. Russell, 146, West Princes Street, Glasgow, electrical engineer; H. E. T. Read, 4, Woodcroft Avenue, Jordanhill, Glasgow, sales manager. Registered office: 18, Otago Street, Glasgow, W.2.

Colour-Animation Advertising (Great Britain), Ltd.—Private company. Registered April 7th. Capital, £10,000 in 1s. shares. Objects:—To carry on the business of contractors for, dealers in, and manufacturers of electrical and other devices, machinery, contrivances, signs and apparatus relating to and for the display of advertisements and announcements, and all branches of publicity, &c. The subscribers (each with one share) are:—A. D. Poulter, 59, Rectory Road, Chelmsford, clerk; Joan Peachey, 9, Hetley House, Hetley Road, W.12, stenographer. Registered office: 1, Charing Cross, W.C.2.

General Wireless, Ltd.—Private company. Registered April 5th. Capital, £1,000 in £1 shares. Objects:—To carry on the business of mechanical, electrical and wireless engineers, &c. The first directors are:—W. R. Bowley, "Sunnyholt," Acton Vale, W.3, wireless engineer (chairman); S. H. Osborne, 10, Cloister Road, N. Acton, wireless engineer (both permanent, subject to holding 500 shares each). Secretary: Grace V. Bowley, "Sunnyholt," Acton Vale, W.3. Registered office: 7a, Church Road, Acton, W.3.

Radio Corporation of Portugal, Ltd.—Private company. Registered April 13th. Capital, £100 in £1 shares. The objects are to acquire all or any of the interest in the undertaking and business known as the Companhia Portuguesa Radio Marconi and the property and liabilities thereof. The subscribers (each with one share) are:—E. A. Hammond, 18, Leith Mansions, Maida Vale, W., solicitor; H. L. Denton, 61, Oldfield Road, Stoke Newington, N.16, clerk. Registered office: 9, Essex Street, Strand, W.C.2.

Official Returns of Electrical Companies.

Electric Construction Co., Ltd.—Satisfaction to the further extent of £2,500 on March 31st, 1928, of 4 per cent. perpetual first mortgage debenture stock secured by trust deed dated December 16th, 1897, securing £200,000 .

Seaton's Stores, Ltd.—C. Semper, 15, Lord Street, Liverpool, was appointed receiver and manager on March 17th, 1928, under powers contained in debenture dated June 28th, 1927.

General Accessories Co., Ltd.—Capital, £3.000 in 1,580 6 per cent. preference, 920 5 per cent. preference, and 500 ordinary shares of £1 each. Return dated September 7th, 1927 (filed February 8th, 1928). All shares taken up. £1,580 paid. £1,420 considered as paid. Mortgages and charges, £3,000.

Ferranti, Ltd.—Satisfaction in full on February 27th, 1928, of mortgage dated September 10th, 1915, securing £100,125.

Radio Service (London), Ltd.—Satisfaction in full on March 15th, 1928, of debenture dated July 25th, 1927, securing £125.

Allen West & Co., Ltd.—Capital, £150,000 in £1 shares. Return dated December 28th, 1927. 141,724 shares taken up. £141,724 paid. Mortgages and charges at date of return, £60,000. Since registered: Debenture dated February 21st, 1928, to secure £40,000.

Simmonds & Stokes, Ltd.—Capital, £10,000 in £1 shares. Return dated February 14th, 1928. All shares taken up. £1,521 paid. £8,479 considered as paid. Mortgages and charges, £3,250.

Invincible Electrical Engineering Co., Ltd.—Capital, £1,000 in £1 shares. Return dated January 14th, 1928. 400 shares taken up. £400 paid. Mortgages and charges nil.

Swedish General Electric, Ltd.—Capital, £5,000 in £1 shares. Return dated February 21st, 1928. All shares taken up. £5,000 paid. Mortgages and charges nil.

Radiant Electrical Co., Ltd.—Capital, £100 in £1 shares. Return dated January 14th, 1928. All shares taken up. £100 paid. Mortgages and charges nil.

International Electrolytic Plant Co., Ltd.—A. Cripwell, 12, Cherry Street, Birmingham, ceased to act as receiver or manager on March 21st, 1928.

Evalasio Distributing Agency, Ltd.—M. G. Hacker, 23, Surrey Street, W.C.2, ceased to act as receiver or manager on March 26th, 1928.

James Gordon & Co., Ltd.—Debenture dated March 27th, 1928, to secure £7,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder:—J. Gordon, 1a, Cavendish Road, St. John's Wood, N.W.

Beriton, Ltd.—Particulars filed of £500 debentures authorised March 26th, 1928, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £400.

City Notes.

Shropshire, Worcestershire and Staffordshire Electric Power Co.

The annual meeting of this company was held on April 12th, the chairman (Mr. E. Garcke) presiding. In presenting the report and accounts (ELEC. REV., April 6th, p. 607), the chairman said that the great attention which had recently been given to the securities of electricity supply companies indicated a confidence in their further progress. Referring to the Central England electricity scheme, Mr. Garcke said that the company and its neighbour the City of Birmingham had long ago put into practice the principles of interconnection and the concentration of plant in large stations; it was therefore difficult to see what advantages the proposals would have in that part of their area. The undertakers in the district had to express their opinions of the scheme before the end of the current month; the directors were closely examining the provisions of the measure with a desire to assist the authorities in their large, responsible, and difficult task. Returning to the company's immediate affairs, the chairman said that the effects of the coal dispute were felt well into April last year, but since then there had been a steady improvement in their output. That was due more to the connecting-up of new consumers than to increased demands from existing industrial consumers. During the year, in conjunction with the Birmingham Electric Supply Department, they had brought into commission a large trunk cable for the interchange of power between the two undertakings. That would be of great benefit in normal business and a stand-by in case of emergency. The company had continued its policy of expansion and considerable extensions of mains had been made into new districts. The directors considered the financial results satisfactory in view of the fact that the heavy industries in the area were suffering from trade depression during the year.

Western Union Telegraph Co.

The income account for the year ended December 31st last records gross operating revenues of $131,771,003 and a net income, including $2,689,814 dividends and interest, of $18,614,784. After deducting $3,584,331 bond interest, a balance of $15,030,453 is carried to surplus account. That account shows a surplus brought forward of $71,404,042, and the addition of the balance on income account (after adjustments) makes $86,509,368. Dividends absorbed $7,980,786, leaving a surplus at the end of the year of $78,528,582. The report mentions that substantial reductions were made in the rates between the United States and South American points and in Press rates between New York and Great Britain. It is considered that the development of radio communication has actually been of advantage to the cable systems, and cables are stated to be still the better method of communication. A decline of 2 per cent. in operating revenues was more than compensated for by a decrease of 2½ per cent. in the working expenses.

Rangoon Electric Tramway and Supply Co., Ltd.

The directors propose to sub-divide the 50,000 cumulative £5 shares into shares of £1 denomination. At December 31st last £69,939 of 4½ per cent. debenture stock and £300,000 of 5 per cent. debenture stock were outstanding. The installation of a 5,000-kW turbo set, with two boilers, was completed during the year and the changing over of the h.p. transmission system from 2,300 to 6 600 V is approaching completion. The raising of the distribution pressure from 115/200 V to 230/400 V was continued. At the end of the year 22 miles of tramway track

had been renewed, and the reconstruction of the main tramway depôt was completed. The car-mileage rose, but the number of passengers decreased. There was a loss on the motor omnibus services. Considerable extensions were made to the distributing system to meet the demand, and 680 consumers were connected. The gross profit was £188,797, and the net profit £60,326 (after transferring £55,000 to renewals reserve, £20,000 to cables reserve, &c.). An addition of £25,573 brought forward makes available £85,899. An interim ordinary dividend of 8 annas per share, free of Indian income tax, has been paid, and a final dividend of Rs. 1-4-0, free of tax, is recommended; £24,232 is carried forward. Mr. P. Henstock has resigned from the board and his place has been taken by Mr. T. F. R. McDonnell. Meeting: Rangoon, April 27th.

Stock Exchange Notices.

Dealings in the following have been specially allowed by the Stock Exchange Committee under Rule 159:—

River Plate Electricity Co., Ltd.—67,000 new ordinary shares of £1 each, fully paid, Nos. 383,001 to 450,000, and fractional certificates.

Compania Hispano-Americano de Electricidad.—Bearer warrants for 400,000 "D" shares of 100 pesetas each fully paid, Nos. 1 to 400,000.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—500 5 per cent. preference shares of £1 each, fully paid, Nos. 1,532,018 to 1,532,517.

Power Investment Corporation, Ltd.—739,250 shares of £1 each partly paid and fully paid, Nos. 260 551 to 999,800.

Shropshire, Worcestershire and Staffordshire Electric Power Co.—300,000 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 300,001 to 350,000 and 1,210,001 to 1,460,000.

Underground Electric Railways Co. of London, Ltd.—9,505 ordinary shares of £1 each, fully paid, Nos. 5,080,363 to 5,089,867.

The undermentioned have been ordered to be officially quoted:—

Underground Electric Railways Company of London, Ltd.—9,134 ordinary shares of £1 each, fully paid, Nos. 5,071,229 to 5,080,362.

Babcock & Wilcox, Ltd.

The net profit for the year ended December 31st, 1927, was £743,820, as compared with £716,577 in 1926. A balance of £161,442 brought forward is added, making £905,262. After meeting the preference dividends, it is proposed to pay a final dividend of 8 per cent., free of tax, on the ordinary shares, making 15 per cent. (against 13 per cent.), free of tax, for the year. The reserve fund receives £100,000 (making £802,000), and the staff pension fund £20,000, leaving £125,362 to carry forward. The report records the death of Mr. E. H. Wells, formerly a director of the company and for many years president of the American Babcock & Wilcox Co. During the year extensions to the factories and plant at Renfrew and Dumbarton were authorised, but not completed, and further additions have been put in hand to bring methods up-to-date and lessen the cost of production. The works in this country are well supplied with orders and the company is employing more men than it was a year ago. Most of the associated companies are doing well. The French and German companies are paying increased dividends and a Japanese company is being formed to deal with business in Japan. Mr. A. G. Pratt has been appointed a director. Meeting: April 25th.

London Electric Wire Co. & Smiths, Ltd.

Sir George H. Fisher-Smith (chairman) presided at the annual meeting on April 12th, and in moving the adoption of the report and accounts (*vide* our last issue, p. 653), said that the cash at bankers and in hand showed an increase of £151,515. It was necessary at times to hold fairly large liquid resources, so that advantage could be taken of any opportunity which might present itself in the furtherance of the company's interests and for the expected expansion of trade. The special reserve had not been increased; it stood at £150,000, which was considered sufficient to ensure the equalisation of dividends during the periods of uncertain trade. In view of the variable nature of customers' requirements, on account of the difficult trading conditions, the year's results could be regarded as satisfactory. There were signs of some recovery of trade. Better industrial conditions prevailed, and he regarded the future as distinctly hopeful because of the beneficial results which were anticipated from the working of the recent electrical legislation. During the last few years competition both at home and from abroad had been very severe, and although those conditions might still prevail for a time, the company was in a strong position to meet it.

Electrical Finance and Securities Co., Ltd.

The report for the year ended December 31st last shows a net profit of £12,877, to which is added £2,962 brought forward, making £15,839. After meeting the preference dividend and writing off issue expenses there remains £10,223. An interim dividend of 5 per cent. has been paid on the ordinary shares and a final distribution of 1s. per share is recommended; £3,474 is carried forward. Mention is made of the progress of the following undertakings in which the company is interested:—The Northwood Electric Light and Power Co., Ltd.; the Foots Cray Electricity Supply Co., Ltd.; the Colne Valley Electric Supply Co., Ltd.; the Boston and District Electric Supply Co., Ltd.; and the Lothians Power Co., Ltd. The report records the death of the chairman, Mr. James Taylor, and the appointment of Mr. H. T. Barnett to the board. The meeting was held on Wednesday last.

Northern General Transport Co., Ltd.

The report for the year ended December 31st last shows a net revenue of £162,831, and a profit of £76,909. To this is added £2,440 brought forward, making £79,349, which it is proposed to apply as follows:—To reserve, £10,387; to debenture sinking fund, £2,290; preference dividend, £9,000; dividend of 10 per cent. on the ordinary shares (2½ per cent. already paid), £44,375; leaving £13,297 to be carried forward. The capital expenditure during the year was £55,554, mainly in respect of rolling stock and the purchase of land. The return from the company's investments in associated companies increased. The Gateshead and District Tramways Co. paid an ordinary dividend of 10 per cent.; the Tynemouth and District Electric Traction Co. paid 7½ per cent.; but no dividend was paid by the Jarrow and District Electric Traction Co. Mr. C. Shirreff Hilton has resigned his seat on the board. Meeting: April 26th.

Cia. Hispano-Americana de Electricidad.

Particulars of this Spanish company were published last week as a preliminary to the introduction of its shares to the London Stock Exchange. The company has an authorised capital of 200 million pesetas (about £7,000,000), and was formed to construct and operate electrical plants of every description and to acquire and administer enterprises in the field of applied electricity, particularly lighting, power and transport. Its initial object was to acquire the entire assets of the Deutsche-Ueberseeische Elektricitäts Gesellschaft, Berlin; later its activities were extended to Argentina, Mexico, Spain, France, Belgium, and Germany. The board is international in character, and the British directors are Mr. B. D. Docker, Sir E. Wyldbore Smith, and Mr. C. H. Sanford. Another director is Dr. Felix Deutsch, president of the Allgemeine Elektricitäts Gesellschaft, Berlin.

British Automobile Traction Co., Ltd.

Speaking at the annual meeting on April 12th, the chairman (Mr. S. E. Garcke) referred to the proposed merger of the company with Thos. Tilling, Ltd., the British Electric Traction Co., Ltd., and Associated Companies, and said the B.E.T. omnibus interests had become so large in relation to the tramway operations that many of the concerns were now virtually omnibus undertakings. The report and accounts were adopted, and at a subsequent extraordinary meeting resolutions were passed providing for the raising of the capital to £2,000,000 by the creation of 1,400,000 ordinary shares of £1 each, and changing the company's name to "Tilling and British Automobile Traction, Ltd."

South Wales Electrical Power Distribution Co.

The net income for the year 1927 was £125,068, and after meeting debenture interest there is a balance of £61,002 which it is proposed to distribute as follows:—To depreciation account, £44,220; dividend on 5 per cent. preference shares; paid over to the South Wales Power Co., £10,516.

South Wales Power Co., Ltd.

As shown above, the sum of £10,516 is received from the South Wales Electrical Power Distribution Co. in respect of 1927. The return on the Power Company's holding in the Distribution Company, together with interest on investments, &c., gives an available balance of £66,496, to which is added £10,991 brought forward, making £77,487. After paying debenture interest, the 6½ per cent. cumulative preference dividend and directors' fees, a balance of £20,706 is carried forward.

Direct Spanish Telegraph Co., Ltd.

The net profit for the year ended December 31st, 1927, was £10,548 (including £900 brought forward). The usual dividend of 10 per cent., free of tax, is paid on the ordinary shares and £1,083 is carried forward. The Porthcurnow-Bilbao cable No. 1 became interrupted in December last and remained out of action for 36½ days; owing, however, to the duplication of the cable no traffic was lost. The meeting was to be held yesterday (Thursday).

River Plate Electricity Co., Ltd.

The net revenue for the year ended December 31st, 1927, was £51,759, and the addition of £7,576 brought forward makes available £59,335. A sum of £10,833 is carried to reserve, making it £363,833. It is proposed to capitalise £63,833 and distribute it in the form of ordinary shares to present shareholders in the proportion of one to each six held. The final ordinary dividend is 8 per cent., making 11 per cent. for the year.

International General Electric Co.

The net income from selling operations rose from $806,752 in 1926 to $1,058,399 in 1927. The amount of dividends, &c., was lower at $2,569,975, and the available profit increased from $1,538,306 to $1,556,335. The sum paid out in dividends (including 8 per cent. on the common stock) was the same, and the balance added to surplus was $56,335, making a total of $11,954,912.

West London and Provincial Electric and General Trust, Ltd.

From the past year's profits £2,500 has been transferred to general reserve. A final dividend of 6 per cent., making 10 per cent. for the year (against 8 per cent. for 1926), is to be paid, and £3,213 is carried forward.

Cornwall Electric Power Co.

After providing for all expenses, including depreciation, the profit for the year ended December 31st last was £26,135. From this £5,000 is transferred to reserve and a dividend of 8 per cent. is paid on the ordinary shares. The Cornwall Power Co., Ltd., reports a profit of £20,728, to which is added £1,209 brought forward, making £21,937. The ordinary dividend is 5 per cent., and £2,588 is carried forward.

Canadian General Electric Co.

The report for the year ended December 31st last shows a net profit of $2,103,053, after providing $800,000 for depreciation. Of this $1,352,888 is applied to the reduction of plant values, and $2,823,751 brought forward is added, making $3,573,9.6. After paying the preference dividend the surplus is $2,974,873.

Merthyr Electric Traction and Lighting Co., Ltd.

The net revenue for the year ended December 31st, 1927, rose from £24,072 to £25,897, and after meeting all charges, including renewals (£7,000), there is a surplus of £3,683, against £918 in 1926. A balance of £3,148 brought forward is added, making £6,831; it is proposed to pay an ordinary dividend of 2½ per cent., leaving £3,706 to be carried forward.

Weston-super-Mare and District Electric Supply Co., Ltd.

The net revenue for 1927 rose from £34,448 to £39,755 and the net profit from £10,721 to £15,833. The dividend on the ordinary shares is maintained at 10 per cent., the allocation to reserve is raised from £4,000 to £7,000 and £4,959 is carried forward.

Lewes and District Electric Supply Co., Ltd.

The net income for the past year was £11,599, against £10,683 for 1926, and the net profit £4,522, against £3,868. It is proposed to transfer £2,000 to reserve and to pay an ordinary dividend of 10 per cent., as in 1926, leaving £3,404 to be carried forward.

J. Stone & Co., Ltd.

To a net profit of £234,555 for 1927 (against £180,011 for 1926) is added £72,893 brought forward, making £207,448. The reserve receives £50,000 (against £45,133), and the ordinary dividend is maintained at 15 per cent. The amount carried forward is increased from £72,893 to £128,388.

Great Northern Telegraph Co., Ltd., of Denmark.

The directors propose to distribute a total dividend and bonus of 20 per cent., including the 5 per cent. already paid, for the year 1927, and to transfer £30,556 to the reserve and renewal fund, while £37,500 has been allotted to the pension fund. £219,308 is to be carried forward.

Penarth Electric Lighting Co., Ltd.

The net revenue for the past year rose from £11,075 to £12,217, and the net surplus (including £2,482 brought forward) is £7,425. An ordinary dividend of 7½ per cent. is recommended, and it is proposed to place £2,000 to reserve and carry forward £3,200.

Canada Northern Power Corporation, Ltd.

This week this Canadian company advertised an issue of $15,000,000 5 per cent. 25-year collateral trust sinking fund gold bonds (part of an authorised amount of $50,000,000), at 98½ per cent. The company owns or controls a number of hydro-electric and other properties in Canada.

Costa Rica Electric Light and Traction Co., Ltd.

The net earnings in Costa Rica during the year ended June 30th, 1927, were £27,751 and the net profit was £9,615. The balance of net profit has again been placed to the depreciation and renewals account. During the year £2,000 of 6 per cent. prior lien debentures were redeemed.

Herbert Morris, Ltd.

A dividend at the rate of 7½ per cent. per annum has been declared on the ordinary shares in respect of the half-year ended January 31st last.

Thos. W. Ward, Ltd.

It is proposed to raise the capital to £1,850,000 by the creation of 375,000 ordinary and 125,000 second preference shares of £1 each.

Brazilian Traction, Light and Power Co.

A quarterly dividend of 1¾ per cent. (payable June 1st) has been declared on the ordinary shares.

Wood & Cairns, Ltd.

The directors recommend a dividend of 7½ per cent., both on the preference and ordinary shares for the past year.

Indo-European Telegraph Co., Ltd.

The directors recommend a final dividend of £1 2s. 6d. per share, making 7 per cent. for the year, together with a bonus of 15s. per share, making the total distribution for the past year 10 per cent., all free of tax, as for the preceding year.

Belgian Companies.

The *Compagnie de Tramways et Electricité* reports net profits of 1,334,000 fr. for 1927 against 1,058,000 fr. in the preceding year. The dividend is 22.50 fr. per share, against 20 fr. in 1926.

The *Compagnie Générale de Railways et d'Electricité* records net profits of 16,410,000 fr. for 1927, as against 10,684,000 fr. in the previous year. The dividend is 47.50 fr. per share, as compared with 42.50 fr. in 1926.

The *Société des Ateliers de Constructions Electriques de Charleroi* reports a net surplus of 10,946,000 fr., as compared with 9,065,000 fr. in the previous year. The dividend is at the gross rate of 30 fr. per share (12 per cent.) as against 25 fr. (10 per cent.) in 1926.

The *Société Belge pour la Fabrication des Câbles et Fils Electriques*, Brussels, reports that 1927 was a particularly satisfactory year, and the programme of modernisation and extension of the works is being continued. It is proposed to pay a dividend of 49.85 fr. per share, as against 34.41 fr. in 1926.

The *Société de Constructions Electriques de Belgique* states that the stocks of machines in consuming centres in Belgium and abroad were increased. This necessitates further working funds and as a consequence the profit of 4,849,000 fr. has been carried forward.

German Companies.

The *Hartmann and Braun Company*, Frankfürt-am-Main, proposes to increase the rate of distribution from 8 per cent. in 1926 to 10 per cent. for 1927.

The *United Insulator Works Co.*, Berlin, reports net profits of 22,000 marks for 1927, as compared with a loss of 474,000 marks in the previous year. The results permit of the payment of a dividend of 6 per cent. on the preference capital, leaving a small balance to be carried forward.

The *Bergmann Electricity Works Co.*, Berlin, records net profits of 4,470,000 marks for 1927, as compared with 3,150,000 marks in the preceding year. It is proposed to pay a dividend of 9 per cent. on the share capital of 44,000,000 marks, this comparing with 8 per cent. on 33,000,000 marks in 1926.

The *North German Cable Works Co.*, Berlin, recommends the payment of a dividend of 8 per cent. for 1927, as in the preceding year. It is also proposed to increase the share capital by the issue of new shares for 2,500,000 marks to provide more working capital to deal with the larger turnover.

Swiss Company.

The report of the *Oerlikon Accumulator Company* states that while the turnover in automobile batteries increased, that of stationary batteries was less satisfactory in 1927. After provision for depreciation the accounts show net profits of 704,000 fr., as compared with 960,000 fr. in 1926; the dividend is maintained at 20 per cent.

Dutch Company.

The *Financial Times* reports that the Philips Incandescent Lampworks is to pay a dividend of 21 per cent., against 16 per cent. for the preceding year.

Stocks and Shares.

MONDAY EVENING.

THE Stock Exchange markets are in a condition of abounding activity as regards several of the speculative investment sections. Gilt-edged securities are strong, and a good many purely speculative shares are attracting so much attention as to render the volume of business almost a record in the particular shares which are popular for the moment. At the same time, a very considerable body of business continues to be carried on in other stocks and shares, though in some sections trade is so quiet as to evoke the remark that it is not for many years that the dealers interested in what may be called the unpopular markets have spent so unprofitable a period.

Undergrounds Soaring.

Various features stand out prominently in the lists with which we deal. One is the strength of Underground Electric income bonds, the price of which has risen 12 points in consequence of a violent jump of 2s. 6d. in the price of the ordinary shares, due partially to American buying, but still more to support from home purchasers, who are attracted by the promising outlook for the Underground Electric Railways of London. The prices of the two issues, shares and income debentures, are moving on a mathematical plane as regards their relation to each other, and a point in the income bonds is represented by 2½d. in the price of the shares. So far as other Home Railway stocks are concerned, no important alterations have occurred. The Easter traffics published last week were regarded, indeed, as being somewhat disappointing.

Cable Stocks Buoyant.

Another outstanding feature is the continued strength shown by the Eastern Telegraph quartette. The buying has been on a large scale, and was identified—at any rate to some extent—with American interests. Some doubt has been raised as to whether the projected merger between the cable companies and wireless undertakings will go through as smoothly as was at first anticipated. This produced a pause in the buoyancy of Marconis, but it failed to exercise any check to the strength of the cable stock. It will be observed that Eastern, Eastern Extensions, Globes and Westerns are all considerably higher on the week, while the amount of stock taken up at last week's Stock Exchange settlement was so considerable as to leave the market practically bare of floating supplies other than those which may come in on behalf of holders who are tempted by the current high prices to exchange their securities, with a view to putting the money into something more gilt-edged.

The Shareholder's Dilemma.

Proprietors are puzzled to know what they ought to do about their cable investments. If the proposed arrangement does come into force, and the cable companies, together with the beam system, are worked under one control, there will probably be a rise of 20 to 30 points in Eastern ordinary stock, with corresponding improvements in the prices of Eastern Extensions, Westerns, and Globe Telegraph ordinary shares. Should the scheme fail to materialise, falls of equal extent would be not too much to expect, so that it is not surprising that the shareholder finds himself very much at a loss to know what he should do. It might be suggested that the sale of half a holding, in order that the money should be reinvested in gilt-edged securities, would be a prudent policy, but if there should be an immediate advance of 30 points, say, in Eastern ordinary stock, the man who sold at to-day's figure of 212 would undoubtedly feel annoyed with the instigator of the sale of such amount of stock as he had parted from.

Marconis have been somewhat erratic, but on balance remain without alteration. The price, it may be recalled, touched 72s. 6d. some weeks ago, which is 10s. higher than the present figure. On the other hand, in the early days of this year, Marconis were but little over £2 per share; and here again the scope for bewildering the shareholder is obvious. Canadian Marconis reacted to 28s.

British Columbia Boomlet.

British Columbia Electrics have shot up on very interesting developments which have occurred in connection with the company, for whose deferred stock Lord Rothermere is understood to have bid 280. In the market, following this bid, men were giving 290 and more, while the preferred jumped to 246 and the new deferred to 58s. 6d. Some people had been saying that the company was actually sold to Lord Rothermere, but this did not seem to be the case, and how the whole matter will eventuate remains to be seen. Meanwhile there can be very few proprietors of British Columbia Electric Railway ordinary and preferred stocks who are unable to take a really handsome profit by selling at to-day's figures.

Brazilian Tractions Spurt.

Brazilian Tractions have risen no less than 11 points. Mexico Trams moved somewhat irregularly, and in spite of a fairly general improvement in Mexican securities, the Mexican utility issues have been disposed to droop. The Light and Power common shares are down 4 points, receding once more below par. Mexico Tramways common went back to 46½, after being near to 50, but the company's 5 per cent. bonds are 3 higher at 85. Anglo-Argentine Tramways first preference show a slight advance at 76s. 3d. The London group is quiet: London and Suburban Traction preferences are another 6d. higher at 9s. 6d.

Electricity Supply Shares.

Various ordinary and preference shares in the Electricity Supply section went ex dividend last week. In some cases, part of the deduction was promptly recovered. A notable feature in this group is a rise to £4 in Bournemouth and Poole ordinary shares. This made an improvement of 9s. in the last fortnight. Another feature is a gain of 2s. 6d. in Urban ordinary, which has lifted the price to 50s. County of London, at 38s. 6d. ex dividend, are 2s. 3d. higher on the week. City "Lights," on the other hand, have eased off to 28s 6d. Amongst the foreign division, Tokio sixes are better at 99.

Miscellaneous Matters.

The increase of 2 per cent., to 15 per cent., in the Babcock and Wilcox dividend, has already been noted here, and the report, now published, shows that the increased profit was less than the sum required to pay the additional dividend. Anticipation continues to flirt with the idea of a possible bonus, but nothing is expected to be officially stated until the meeting on the Wednesday, April 25th, in next week. The electrical and cable manufacturing list is steady: Siemens are a few pence higher at 28s. 9d. Rubber shares remain flat by reason of the drop in the price of the produce, and the very uncertain outlook that prevails for the industry over the next few months.

Share List of Electrical Companies.

	Nom. £	Dividend. 1926.	Dividend. 1927.	Price April 16. 1928.	Rise or fall.	Yield. p.c.
Home Electricity Companies.						
Bournemouth and Poole	1	14†	—	80/-	+2/6	3 10 10
Brompton Ordinary	1	8¾	—	26/-	—	5 7 8
Charing Cross Ordinary	1	8½	8½	26/6	—	5 5 8
do. do. 4½% Pref. ...	1	4½	4½	17/6	—	5 2 10
Chelsea	1	8¾	8¾	26/-	—	5 7 8
City of London	1	10	10	28/6	−1/6	4 18 4
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	33 6xd	+9d.	4 14 10
County of London	1	7½	7½	38 6xd	+2/3	3 18 0
do. do. 6% Pref. ...	1	6	6	23/-	—	5 4 4
Edmundsons' Ordinary	1	10	—	67/6	—	2 19 2
do. 7% Pref.	1	7	7	25/6	—	5 9 10
Elec. Supply Corporation ...	1	11	—	52/6	+6d.	4 3 10
Kensington Ordinary	1	8	8	26/6xd	+1/6	5 5 8
Lancs. Light and Power	1	7½	—	30/-	—	5 0 0
London Electric	1	8½	8½	25/6	—	5 9 10
do. do. 6% Pref.	5	6	6	5½	—	5 8 2
Metropolitan	1	8	9	45/-	—	4 0 0
do. 4½% Pref.	1	4½	4½	17.6	—	5 2 10
Midland Counties	1	6	6½	26/-	—	5 0 0
Newcastle-on-Tyne Ordinary ...	1	5	6	2/8xd	−9d.	4 11 3
do. 5% Pref. ...	1	5	5	19/6xd	+1/3	5 2 7
do. 7% Pref. ...	1	7	7	29/-xd	+6d.	5 7 8
Notting Hill 6% Pref.	10	6	6	10¾	—	5 11 7
North Met. Elec. 6% Pref.	1	6	6	2⅜/-	—	5 4 4
St. James' and Pall Mall	5	8	8	26/6	—	5 5 8
South London	1	8½	8½	26/6xd	+1/-	5 5 8
South Metropolitan Pref.	1	7	7	1½	—	6 3 0
Urban Ordinary	1	7	—	50/-	+2/6	2 16 0
do. 6% Pref.	1	6	6	1½	—	5 6 8
Westminster Ordinary	1	8½	8½	26/-	—	5 7 8
Whitehall Elec. Invst. 7½% Pref. ...	1	7½	7½	21/7½	—	6 18 9
Yorkshire Elec.	1	8	8	33/6	—	4 15 7
Home Rails.						
Central London Ord. Assented ...	Stock	4	4	73	−1	5 9 7
Metropolitan	„	3	3	72	+1	4 3 4
do. District	„	3½	4	77½	+2	5 3 3
Underground Electric	£1	1½	5	27 6	+2/6	3 12 6
do. do. Income ...	Bonds	6	6	130	+12	4 12 6
Telegraphs and Telephones.						
Anglo-Am. Tel. Pref.	Stock	6	6	99½	—	6 0 8
do Def.	„	1½	1½	24½	—	6 1 10
Automatic Telephone	1	10	10	45/-	−1/3	4 9 0
Chili Telephone	5	6	—	7⅜	—	*3 18 8
Eastern Extension	10	10	10	21½	+1½	*4 13 0
Eastern Tel. Ord.	Stock	10	10	215½xd	+7	*4 13 0
Globe Tel. and T. Ord.	10	10	10	21½	+½	*4 12 0
do. do. Pref.	10	6	6	10⅞	+⅜	5 1 4
Great Northern Tel.	10	20	—	40	+½	5 0 0
Indo-European	25	10	—	40	—	*5 0 0
Marconi	10/-	5	—	62/6	—	1 12 0
Marconi-Marine	1	8½	12½	48/-xd	+1/6	5 4 2
Oriental Telephone Ord.	1	12	—	53 9	+1/3	*4 9 3
United R. Plate Tel.	5	8	8	11	—	*3 12 9
Western Telegraph	10	10	10	21	+¾	*4 15 3
Home and Foreign Trams, &c.						
Anglo-Arg. Trams First Pref. ...	5	5½	5½	8½	+⅛	7 4 8
do. do. 2nd Pref. ...	5	6	6	8½	—	7 17 4
do. do. 5% Deb. ...	Stock	5	5	78½	—	6 7 5
British Electric Traction Def. Ord.	„	—	—	520	—	... ...
do. do. 8% Pref. Ord.	„	8	—	134½	—	6 8 6
Brazil Traction	100	6	—	246	+11	*2 9 0
Brit. Columbia Elec. Rly. Pcc. ...	Stock	5	5	95½	+1	5 4 9
do. do. Preferred ...	„	6½	6½	245	+5	*2 11 0
do. do. Deferred ...	„	8	8	290	+10	*2 15 2
do. do. Deb.... ...	„	4½	4½	81½	—	5 4 4
London & Sub. Trac. 5% Pref. ...	1	Nil	Nil	9/6	+6d.	... ...
London United Tram Deb. ...	Stock	4	4	57½	—	6 19 2
Mexico Trams, 5% Bonds	—	5	5	85	+3	5 17 8
Mexican Light Common	100	Nil	Nil	98½	−4	... ...
do. 7% Pref...	100	Nil	7	86	—	8 2 9
do. 1st Bonds	—	5	5	83½	+1	5 19 9
Yorkshire (West Riding)	1	Nil	Nil	7/6	+6d.	... ...
Manufacturing Companies.						
Babcock & Wilcox	1	13	15%	70/-	—	4 5 9
British Aluminium Ord.	1	10	10	45/-xd	+1/-	*4 9 0
British Elec. Transformer Pref. ...	1	7	7	19/-	—	7 7 4
British Insulated Ord.	1	15	15	4¾	—	3 12 8
Brush Ord.	1	10	—	29/-	—	6 17 11
Callenders	1	15	—	4¾	—	3 8 2
do. 6½% Pref.	1	6½	6½	23/-	—	5 9 5
Crompton Parkinson Pref. Ord. ...	1	—	—	17/6	—	... ...
Edison-Swan	4/-	10	10	10/-	—	4 0 0
do. 5% Deb.	Stock	5	5	90	—	5 11 0
Electric Construction	1	7½	—	27/-	—	5 11 1
Enfield Cable Pref.	1	7½	7½	26/3	—	5 14 3
English Electric	1	Nil	Nil	8/-	−6d.	... ...
do. do. Pref.	1	3	Nil	12 6	+6d.	... ...
Gen. Elec. Pref.	1	6½	6½	24/-	—	5 8 4
do. Ord.	1	7½	—	36/-	—	4 3 4
Henley	1	25	—	5¾	—	4 9 0
do. 4% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	Nil	Nil	13/9	—	... ...
Johnson & Phillips	1	12½	—	53/9	—	4 12 7
Met.-Vickers Ord.	1	8	6	80/-	—	4 0 0
do. Pref.	2	8	8	21	—	6 1 11
Siemens Ord.	1	7½	—	28 9	+6d.	5 4 4
Telegraph Construction	12	10	10	26½	—	*4 10 11

* Dividends paid free of Income Tax.
† 4% of which was Tax Free.

United States Electrical Exports.

Figures for 1926 and 1927 Compared.

BELOW are shown the values of electrical machinery and apparatus exported from the United States during the 12 months ended December last. Comparative figures for the year 1926 are added, and notes of increases or decreases are also given :—

	1926. Thous. $	1927. Thous. $	Inc. or dec. Thous. $
Electrical machinery and apparatus (total)	84,226	84,565	+ 339
Generators—			
Direct current—			
Under 500 kW	960	871	– 89
500 kW and over	455	650	+ 195
Alternating current—			
Under 2,000 kVA	188	170	– 18
2,000 kVA and over	1,273	1,089	– 184
Steam turbine generator sets	1,412	947	– 465
Accessories and parts for generators	920	2,012	+1,092
Self-contained lighting outfits	1,151	1,339	+ 188
Batteries—			
Flashlight batteries	1,674	2,250	+ 576
Other primary batteries	2,020	2,430	+ 410
Storage batteries	3,443	3,673	+ 230
Transforming or converting apparatus—			
Power transformers	2,231	1,556	– 675
Other transformers	1,266	1,051	– 215
Rectifiers, double-current, and motor generators, dynamotors, synchronous, and other convertors	1,557	1,729	+ 172
Transmission and distribution apparatus—			
Switchboard panels, except telephone	2,193	1,628	– 565
Switches and circuit breakers over 10 A	2,618	1,987	– 631
Fuses and fuse blocks	352	370	+ 18
Watt-hour and other measuring meters	493	419	– 74
Volt, watt and ampere meters and other recording, indicating and testing apparatus	2,152	2,138	– 14
Lightning arrestors, choke coils, reactors and other protective devices	709	726	+ 17
Motors, starters, and controllers—			
Motors under 1 h.p.	2,000	2,614	+ 614
Stationary motors—			
1 to 200 h.p.	3,207	3,067	– 140
Over 200 h.p.	884	403	– 481
Railway motors	1,127	916	– 211
Electric locomotives—			
Railway	1,842	690	–1,152
Mining and industrial	759	631	– 128
Starting and controlling equipment—			
For industrial motors	1,395	1,152	– 243
For electric railway and vehicle motors	203	247	+ 44
Portable electric tools	549	965	+ 416
Accessories and parts for motors	2,181	2,410	+ 229
Electrical appliances—			
Electric fans	948	1,005	+ 57
Electric lamps—			
Metal filament	1,603	1,537	– 66
Other electric lamps	281	440	+ 159
Flashlights	2,058	2,474	+ 416
Searchlights and projectors	574	874	+ 300
Motor-driven household devices	1,744	2,312	+ 568
Domestic heating and cooking devices	1,722	1,558	– 164
Industrial electric furnaces and ovens	253	532	+ 279
Therapeutic apparatus, X-ray machines, galvanic and faradic batteries, &c.	1,478	1,660	+ 182
Telephone apparatus—			
Telephone instruments	437	356	– 81
Telephone switchboards	2,219	727	–1,492
Other telephone equipment	2,468	2,721	+ 253
Railway signals, switches, and attachments	505	770	+ 265
Bells, buzzers, annunciators and alarms	296	319	+ 23
Radio apparatus—			
Transmitting sets and parts	555	401	– 154
Receiving sets	2,874	2,961	+ 87
Tubes	868	1,004	+ 136
Receiving set components	2,016	2,306	+ 290
Receiving set accessories	2,481	2,510	+ 29
Telegraph apparatus	1,018	1,037	+ 19
Other electrical apparatus—			
Spark plugs, magnetos, and other ignition apparatus	1,904	2,007	+ 103
Insulating material	1,380	1,360	– 20
Metal conduit, outlet, and switch boxes	1,164	1,038	– 126
Sockets, receptacles and lighting switches	1,718	1,803	+ 85
Electric lighting fixtures, interior and street	1,860	1,902	+ 42
Other wiring supplies and line material	1,164	1,358	+ 194
Other electrical apparatus	7,423	7,462	+ 39
The following, not included in the total of electrical apparatus, were also exported :—			
Insulated iron or steel wire and cable	276	191	– 85
Insulated copper wire and cable	4,816	5,172	+ 356

Factors in Industrial Efficiency.

A Further Report by the Committee on Industry and Trade.

AS we indicated in our last issue, the Balfour Committee on Industry and Trade has produced the fourth of its six preliminary reports. This volume, "Further Factors in Industrial and Commercial Efficiency" (Stationery Office, 3s. 6d. net), comprises 360 pages of well-digested evidence, supported by statistical tables and covers a very wide ground. In the space at our disposal we cannot do more than give a meagre outline of the general scheme of the report, but we have endeavoured to treat more thoroughly the particular parts of it which directly concern the electrical industries.

The Census of Production, 1924.

After an introductory summary there is a section reviewing the results of the Third Census of Production, 1924; this, in effect, is a *résumé* of Preliminary Reports, Nos. 1 to 25 and No. 29, which we have mentioned as they were issued. These reports deal with 90 industries in the more important groups and in the summary it is shown that the total number of persons employed in them rose from 5,080,300 in 1907 to 5,967,200 in 1924—an increase of 17 per cent. In studying the amount of power employed by the industries, it is found impossible to separate electrical from mechanical power owing to overlapping between motors and generating plant, &c. Accordingly, only the total power of engines in works is shown for 1907, and the 1924 figures include motors actuated by purchased electricity. The grand totals show a rise from 9,554,600 h.p. in 1907 to 19,884,200 h.p. in 1924. The power per head of persons employed rose, on this basis, from 1.8 h.p. in 1907 to 3.3 h.p. in 1924—an increase of 83 per cent. The lowest increase occurred in the case of the mining and quarrying industries (25 per cent.) and the highest (217 per cent.) in the skins and leather trades. The net output per head rose from £105 to £206, an increase of 96 per cent. All the groups showed an increase of over 100 per cent., except mining and quarrying (41), and metals, machines, implements and conveyances (88). It is noteworthy that these two groups between them employ more than half of the numbers dealt with, *viz.*, 22.1 and 33.0 per cent. respectively.

Costs of Production and Distribution.

In the following section the Committee analyses and compares to the best of its ability the costs of production and distribution in a pre-war year and a post-war year, and summarises the results of its investigations in tabular form. The pre-war costs are taken as a basis and are split up into materials, wages and salaries, and "other expenses" (including power, lighting, heating, depreciation, taxation, insurance, and many other items). The electrical engineering section presents the industry generally, and motors, and cables separately, and is reproduced below :—

	Pre-War Period. (Total = 100).			Post-War Period. (Pre-War total cost = 100).			
	Materials.	Wages.	Other expenses.	Materials.	Wages.	Other expenses.	Total.
Elec. engineering	48·3	26·3	25·4	77·8	52·1	53·1	183·0
Motors	46·9	25·2	27·9	68·5	34·2	42·3	145·0
Cables	78·1	12·4	9·5	97·6	33·6	19·2	150·4

It is to be noted that the item "other expenses" includes salaries partly or wholly. The position is not easy to take in

at a glance owing to the method adopted, but it will be found that so far as the first two items are concerned the percentages are not enormously different in the two periods. In the cable section, however, the percentages for the post-war period are 64.9, 22.3, and 12.8 respectively, exhibiting a very large increase in the proportion of wages to the total. In the course of a survey of the proportions of the three items in various industries, the report shows that the cost of power, lighting, heating and water varies within wide limits. In cotton weaving it represents only 1 per cent. of the cost, while in heavy chemical manufacture it may be as much as 17 per cent. of the total. The average appears to be between 2 and 3 per cent.

Materials are dealt with generally, and it is shown that fluctuating prices have a bad effect upon production costs as manufacturers cannot endanger their solvency by manufacture on the largest scale of which their works are capable, owing to the danger of a collapse of the market in the meantime. Stabilisation of prices could not fail to have beneficial results. Next the effects of "vertical" organisation, location, and royalties on the cost of materials are considered. A tabular statement comprising pre-war and post-war wages makes manifest the well-known fact that the remuneration of unskilled labour has increased to a greater extent than that of skilled labour. In some industries costs have been reduced by simplification and improvement. Of such is the electric motor industry. It is stated that a motor of the same h.p. as a standard type made before the war could be produced (in 1924) at an increase in cost of only 45 per cent., whereas an exact replica of the earlier model would have cost 70 per cent. more. Other examples of the reduction of costs by improved methods are cited. There is difference of opinion regarding the effect of shorter working hours upon production costs.

Electric Power in Industry.

Other factors are dealt with in a general manner and then special mention is made of the advance in the use of electric power in industry. In coal-mining, for instance, the total capacity of electric motors rose from 492,000 h.p. in 1912 to 1,568,360 h.p. in 1924. In the cycle and motor trades the horsepower of electric motors used represented in 1924 over ten times that of the directly-applied mechanical power. A large, and in some industries the greater, part of the electric power used in industry is generated by the works themselves, but the sale of energy by authorised undertakings for power purposes is rapidly increasing. In 1920-21 it amounted to 2,499 million kWh, in 1921-22 to 2,104.7 million, in 1922-23 to 2,548.5 million, in 1923-24 to 3,098.1 million, and in 1924-25 to 3.533 million. In the same period the average price per kWh gradually declined from 1.69d. to 1.07d. It is noted that the charges vary widely in different localities—even neighbouring ones—and the report says: "With the development of the great areas now in contemplation many of the large differences in price will presumably diminish or vanish."

Local Rates and Transport.

The question of local rates and their effect upon production costs were dealt with in an earlier report, but attention is directed to two important aspects. The first is the great difference in the changes which have occurred in various districts since 1913. The second is the fact that in times of prolonged trade depression not only do local rates bulk larger as an element in the cost of production by reason of being spread over a small output, but they are actually increased by reason of the more extensive poor relief which results from chronic unemployment. Figures are reproduced to illustrate this point. From a later table it is seen that in the case of the electrical engineering industry the proportion of the total cost represented by rates, property tax and social charges rose from 1.5 per cent. in 1913 to 4.7 per cent. in 1923. In actual values these items increased by 860 per cent.

The next matter dealt with is the cost of distribution, and passing reference is made to the extension of the practice of large retailers of purchasing directly from the manufacturers. This leads to a consideration of transport costs. Statistics furnished by the railway companies are reproduced showing the great rise in working expenses (mainly wages) between 1913 and 1924. The net receipts are said to have shrunk from 35.2 to 17 per cent. of the total receipts. In another part of the report the competition between railway and road transport is touched upon.

Over-Capitalisation.

This subject forms the substance of another section of the report and a special appendix is devoted to monopolies such as electricity undertakings. It is observed that authorised electrical undertakings, being subject to restrictions, are unlikely to become over-capitalised, and thus there is no danger that prices are likely to be increased on this account. Power companies work under somewhat different conditions. They, too, however, are subject to certain restrictions, but they also have to meet competition from other forms of energy and private generating plant. There is no control over the method of issuing capital in the case of authorised distribution or power companies. This may result in a form of over-capitalisation in two ways. First, it is possible for these companies to issue shares to their shareholders at par or at a premium less than could have been obtained in the open market. The resulting difference between the cash actually received and the amount which might have been obtained is virtually a bonus to the shareholders. In such cases, the capital of the company on which dividends have to be paid is clearly larger than it would have been if the premiums which could have been obtained had been secured and had been applied to capital expenditure. Secondly, a company may obtain the whole of the capital required by issuing ordinary shares instead of loans or debenture stock, preference shares and ordinary shares in reasonable proportions, with the result that the necessary remuneration for capital is increased to the disadvantage of the consumers. This possibility has been guarded against in the case of the London companies.

The Distribution of Industries.

In a section devoted to this subject it is stated that the electrical manufacturing industry is mainly centred in Greater London, Lancashire, and Warwickshire. In the manufacture of generators, motors, &c., the percentages were: Lancashire 32, London 15, and Warwickshire 15—a total of 62 per cent.; in the manufacture of cables, &c., they were London 55 and Lancashire 15—a total of 70 per cent.; in the manufacture of incandescent lamps 80 per cent. were in London; and in "other electrical manufactures" the percentages were: London 33, Lancashire 26, and Warwickshire 15—a total of 76 per cent. Following upon a study of facilities (railways, shipping, &c.), the geographical distribution of the industrial population is considered. The most prominent fact which emerges from this is that there has been a far greater increase of employment in the southern part of the country than in the northern part during the last four years. Out of a total increase of 601,200 insured persons the south claimed 433,000, or 72 per cent. The electrical engineering industry is one branch which has contributed to this result. The increase in the four years was 28 per cent. in the south and 25.9 per cent. in the north. This southward movement of the centres of gravity of certain trades is said to be partly due to causes connected with the supplies of raw materials and the industrialisation of non-urban areas in the south. It is likely to be stimulated by the transmission of electric power to rural districts and other forces making for decentralisation.

(To be concluded.)

Research in the Electrical Industry.

A brief Review of the Annual Report of the Department of Scientific and Industrial Research for 1926-27.

ALTHOUGH the publication of the annual report for 1926-27 of the Department of Scientific and Industrial Research has already been briefly mentioned,* limitation of space has hitherto prevented any reference to the work accomplished commensurate with its importance. The primary position in the Report is naturally occupied by the achievements of the National Physical Laboratory,† considerable space in both the D.S.I.R. and the N.P.L. Reports being needed to outline the valuable work carried out for the Radio Research Board, which is very varied. For instance, a *résumé* of the literature covering thermionics as applied to radio valves is nearing completion, an exchange of views with manufacturers regarding the desirability of further fundamental research has taken place, and a programme of investigations on this subject is under consideration. Meanwhile, experimental work is being carried out at King's College, London University, under the supervision of Prof. Appleton with the object of checking the theory at present advanced to account for the working of "soft" valves and the action of positive ions in them. Further work on the causes of the loss of the dull-emitting properties of low-temperature valves was carried out by Dr. A. C. Davies under the supervision of Prof. F. Horton at the Royal Holloway College, London.

Intense Magnetic Fields.

The grant made to Sir Ernest Rutherford to enable him to carry out research with the special apparatus constructed at the Cavendish Laboratory, Cambridge, for the production of intense magnetic fields was continued. A description of the apparatus developed, which has been published in the *Proceedings* of the Royal Society, deals not only with the special dynamo and switch designed to generate intense electric currents over a short interval of time, but also with the design of the coils employed for the production of the magnetic fields. The problem of making a sufficiently strong coil to resist magnetic fields of the values obtainable, proved one of the most difficult parts of the whole investigation, and much research was necessary to evolve a construction which would stand the strain without bursting. A coil has been produced which allows of the use of fields up to 320,000 gauss in a volume of 2 c.c. With a field of this magnitude only about one-fifth of the power available from the dynamo is used; by using full power and diminishing the inside opening of the coil to 1 cm. it is expected to obtain fields up to 700,000 gauss. In certain

* ELEC. REV., February 17th, 1928.
† ELEC. REV., April 13th, 1928.

experiments a half centimetre opening is sufficient, and in this case fields up to 900,000 gauss could be obtained.

Research on Illumination.

The work of the Illumination Research Committee was continued, and some useful results were obtained. In particular, the work on the effect of illumination on the ease of carrying out fine manipulative processes was extended to include an investigation of a number of different systems of lighting. The adoption, now almost universal, of the mean spherical candle-power rating for electric lamps has led to a demand, by all interested in lamp testing, for a simple exposition of the principles and practice of this special type of photo-metric measurement and the use of the special form of apparatus generally employed. This demand has resulted in the inclusion in the series of Illumination Research Technical Papers of a description of the kind desired, written specially for the information of the non-specialist in photometric work.

Considerable progress was made in the research into the relation between glare and visibility in street lighting, a model street having been designed for the carrying out of practical experiments. An investigation into the effect of the distribution and colour of various systems of lighting on clerical work was also completed, and an investigation of the electric arc as a standard of light is being undertaken at East London College on behalf of the Committee.

Electro-deposition Research.

Investigations on electro-deposition were continued at the Research Department, Woolwich Arsenal, the Royal Aircraft Establishment, Farnborough, and Sheffield University, under the supervision of a committee of the Department containing representatives of industrial interests. Considerable further progress was made with the investigation into the causes and prevention of pitting in electro-deposited metal at Woolwich; so far, attention has been confined to the electro-deposition of nickel, and it is considered that the occurrence of pitting has been shown to be due to the formation of adherent bubbles of hydrogen, and they may arise from such causes as impurity of the electrolyte and also from surface defects in the steel. The conditions affecting these factors, and methods of prevention, are under further investigation.

Arrangements were made for co-operation in research and exchange of information between the Research Department, Woolwich, and the British Non-Ferrous Metals Research Association, upon problems of the electro-disposition of nickel. Work was in progress during the year at the Royal Aircraft Establishment on the deposition of zinc on aluminium with a view to protection against corrosion. Experiments have been carried out in baths consisting primarily of zinc sulphate, and certain solutions which have given the best results have been selected for more detailed investigation. Work has so far been confined to aluminium alloys, but it is hoped to extend it to steel, copper and brass.

The investigations at Sheffield have been directed towards the measurement of internal stress in electro-deposited nickel. Improved methods of measuring the stress in layers of electro-deposited metals have been developed and used in studying the conditions determining the intensity of stress produced. The effect of higher temperatures of deposition in diminishing stress has been confirmed, and some preliminary, but promising, results have been obtained by the superposition of alternating current on the direct depositing current. The relation between deposition and stress has been studied. Certain work has also been carried out on the deposition of silver.

Other Features.

A feature of the report is that references to the publications containing the results of the research work carried out are appended to each section, and should be of great value to those interested; they include many papers and reports issued through H.M. Stationery Office, which do not receive a large measure of publicity and may easily be overlooked. Finally, it may be mentioned that since October, 1920, down to the end of July last the Department has made grants to the British Electrical and Allied Industries Research Association to the extent of £57,701.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

A Transformer Safe-Load Indicator.

The transformer safe-load indicator recently introduced by Messrs. FERRANTI, LTD., Bush House, W.C.2, has its principle of operation based upon the measurement of the "hottest-spot" temperature, or the hottest oil temperature plus the winding gradient. The instrument consists of a dial thermometer, the bulb of which is immersed in the hottest oil of the transformer. Surrounding the bulb is a small resistance coil connected to the secondary winding of a current transformer, and carrying a current proportional to the load current.

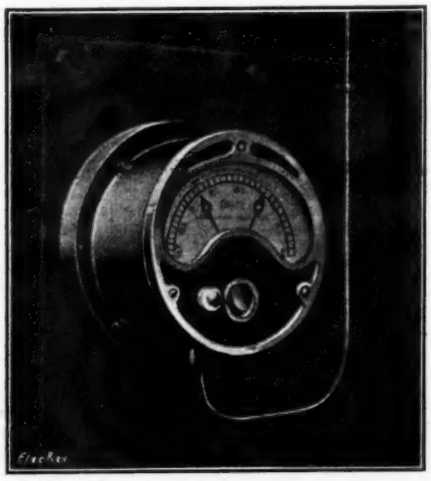


Fig. 1.—Safe-Load Indicator.

This coil is so designed that it increases the temperature of the bulb by an amount equal to the winding gradient, so that the bulb temperature is actually the same as the "hottest spot" temperature in the transformer windings. Instead of being calibrated directly in "hottest spot" temperature, the instrument indicates, while the transformer is in service, the percentage of the maximum safe rating actually being utilised under the existing loading conditions. At light loads the reading is affected slightly by the temperature of the cooling medium, but under normal conditions the error is practically negligible. In special cases, however, a simple method of adjustment is provided to correct for errors due to wide variations in the temperature of the cooling medium. At the higher loads the instrument readings become independent of the cooling-medium temperature. In construction the instrument is robust. The thermometer movement is of a high-grade mercury-in-steel expansion type, and is fitted with a maximum-reading pointer. The instrument may be mounted either on the transformer or on the control panel some distance away. The current transformer for supplying the heating resistance is usually mounted inside the main transformer tank, so that no external electrical connections are required.

When the indicator is fitted to an existing transformer, the current transformer may either be mounted in the tank of the main apparatus or in the switch cubicle, and connected on either the primary or secondary sides. Contacts for giving an alarm and/or tripping the main switches when the load on the transformer reaches a predetermined value can be fitted to the instrument. A recorder can be fitted to the instrument if required.

The conditions for sludge formation on the heating coil of the indicator are somewhat worse than on the coils of the transformer, and the temperature of the bulb of the instrument will be increased by the sludge in the same way as the "hottest spot" temperature; in consequence, the transformer may still be loaded with safety up to the 100 per cent. reading on the indicator. Fig. 1 shows the indicator portion in position.

A Firedamp Indicator Lamp.

The Secretary for Mines announces that on March 13th he made an Order under Section 33 of the Coal Mines Act, 1911, as amended by the Coal Mines General Regulations (Safety Lamps), 1927 (H.M. Stationery Office, price 2d. net), approving the "Ringrose" (firedamp alarm) lamp for use in all mines to which the Act applies, subject to certain conditions set out in the Order. This lamp is intended, not as a means of lighting, but to give visible warning of the presence of dangerous percentages of firedamp in air. A current of air passes into the lamp through protecting gauzes to a combustion chamber consisting of a porous pot containing a heated wire. If, and so long as, firedamp is present in the ingoing air, it is continuously burned by the hot wire, and a partial vacuum is thus created and maintained inside the porous pot. This vacuum deflects an aneroid diaphragm is

such a way that it completes an electric circuit which lights up a red bulb as a warning of the presence of firedamp in the air. The apparatus is adjusted so that the circuit is not completed and the warning light is not shown until the percentage of firedamp in the air exceeds a fixed minimum limit, which can, by readjustment by the makers of the lamp, be varied if necessary. The warning light remains on as long as firedamp in excess of the fixed limit is present in the air. The essential features of the lamp are shown in the accompanying illustration, fig. 2, which is of the upper part of the lamp. A filament of palladium wire, which has a loading of 1.05 A, is suspended across the terminals of the

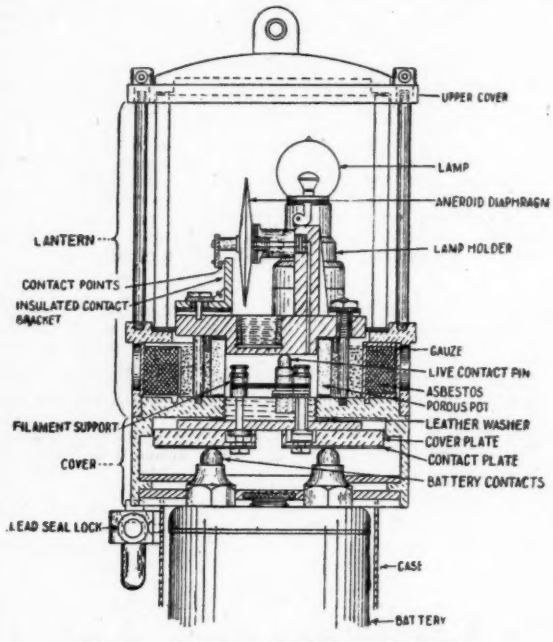


Fig. 2.—" Ringrose " Firedamp Indicator.

filament support, the contact pins of which make electrical connection with two brass contact pieces embedded in the insulating material on the lower side of the contact plate. The lantern is fitted with a cylindrical well glass, protected by means of six brass pillars, which also serve to support a crown of aluminium to which is attached a carrying handle. The flange of the lantern is provided with ventilation holes protected by means of a baffle ring of two concentric brass gauzes, between which is a layer of asbestos wool, which serves to exclude dust from inside the lantern. The makers of the lamp are Messrs. W.R. PATENTS, LTD., Greek Street, Leeds.

A New Electric Fire.

A recent introduction of Messrs. THERMOPATH CO., LTD., 59, New Oxford Street, W.C.1, is the " Meracol " No. 4 screen fire. This is fitted with a tilting projector. The elements are

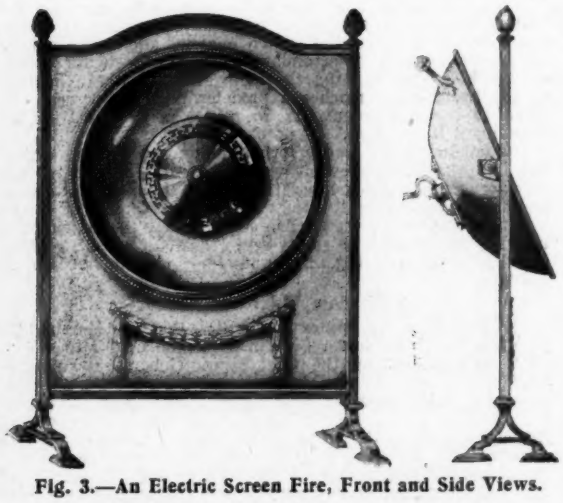


Fig. 3.—An Electric Screen Fire, Front and Side Views.

claimed to be of a new and improved design, in which the resistance wire is keyed into special heat-resisting material, and to give the maximum of radiant heat. They are also of the plug-in type. Fig. 3 shows front and side views of the fire.

A Combined Lamp and Sign Fitting.

The " Prido " fitting, depicted in fig. 4, a production of Messrs. PRIDEAUX & CO., LTD., Midland Lamp Works, Macdonald Street, Birmingham, is designed specially to serve either as an outside lamp and sign for business premises or as a street lamp and traffic sign. One lamp (500 W) provides the illumination for both the sign and the globe. The four sign panels are interchangeable, each measuring 12 in. by

Fig. 4.—The " Prido " Lamp and Sign Fitting.

4 in. The globe dimensions are 11 in. by 9 in., and the overall measurements for the fitting are 23 in. by 13 in. The metal housing is of heavy-gauge copper, and is fitted with a polished aluminium internal reflector. Ornamental wrought-iron brackets can be supplied if required, and various finishes for the metal work and designs for the panels can be obtained.

Insulating Materials.

We have received from the IOCO RUBBER & WATERPROOFING CO., LTD., Netherton Works, Anniesland, Glasgow, W.2, a very neat case of samples of its " Formapex " and " Linapex " insulating products. The former products include synthetic resin varnish, Miocarta boards, tubes, and so on, synthetic resin varnish paper bushings, plain and condenser types, synthetic resin varnish treated paper, and synthetic resin moulding powders and varnishes; the latter include varnished cloths, silks and tapes. " Formapex " is claimed to be a very highly developed example of phenol formaldehyde possessing the characteristics of infusibility and insolubility when the process of manufacture is complete. A further claim for the " Formapex " products is that it is impossible to cause softening, blistering or disintegration at temperatures as high as 150 deg. C. in the case of paper or cloth-base materials, or 200 deg. C. where asbestos is employed. " Linapex " varnished cloth is a carefully selected cotton fabric coated on both sides with a flexible insulating varnish. The special varnish treatment of the cloth is claimed to result in a fabric of uniform thickness and electrical properties. In order to meet the testing requirements of the users, " Linapex " fabrics are tested at 194 deg. F. A speciality of the products are bakelite-type " Formapex " wireless panels, which are guaranteed to satisfy the most exacting demands of high-frequency circuits, having, it is claimed, exceptionally high surface resistivity and dielectric strength. They can be easily drilled, tapped and machined, and will not soften or warp with heat. Further, they are claimed to be unaffected by dilute acids, alkalies or ozone. They are supplied in two finishes, polished black and mahogany, of very pleasing appearance. The numerous uses to which the products referred to above can be put together with many test data, are contained in lists Nos. 10 and 11 issued by the makers.

A New Lead Terminal.

We have received from Messrs. CLARKES, Sinew Works, Redditch, a sample of the " Paragon " lead terminal for use in connection with high-tension units on automobiles. Contact with the conductor is made by means of a coarse threaded contact screw on the end of a terminal eye piece, which is screwed into the centre of the cable core so that the conductor strands become embedded around the thread. A terminal sleeve which is first passed over the end of the lead acts as a guide for the screw piece.

A New Magneto Key.

Messrs. RUNBAKEN MAGNETO CO., Tipping Street, Ardwick, Manchester, have sent us a sample of their new production, the De Luxe magneto key. This is similar to the " Quixo " magneto key, which was described in our issue of January 6th, p. 39, except that the screw driver-and-reamer unit is now detachable. The combination is supplied complete in a neat leather container.

London's Terminal Aerodrome.

A description of the new radio-telephone and telegraph equipment which has been installed by Marconi's Wireless Telegraph Co., Ltd., for the Air Ministry at Croydon.

THE progress of military aviation is generally recognised, but the development of civil flying is not perhaps appreciated sufficiently. That the modernisation scheme of London's terminal air port for the Anglo-Continental aeroplane transport services is justified, is made evident by the facts that last year the number of passengers arriving at and departing from the Croydon aerodrome averaged 60 per day, or over 20,000 for the year; moreover, the total value of imports and exports amounted to £10,000,000, chiefly accounted for by the large amount of bullion carried by air.

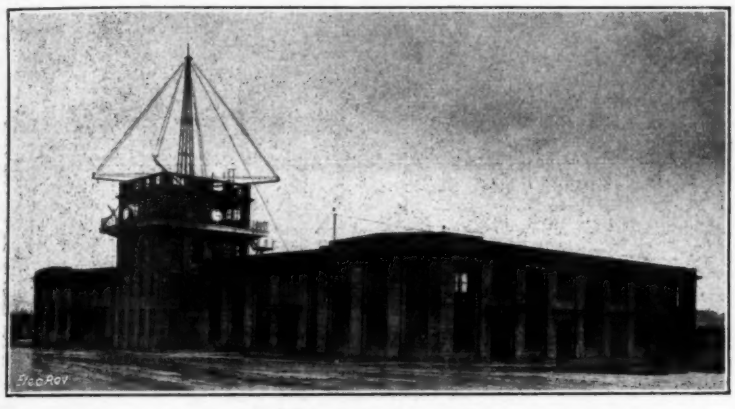


Fig. 1.—Terminal Building and Control Tower at Croydon.

A modern air liner will accommodate 18 first- and second-class passengers, besides a crew of three, and the importance of radio communication between machines in flight and aerodromes cannot be over-estimated; it is an essential factor of safety and convenience in aerial navigation. The equipment of the new aerodrome has been carried out to the Air Ministry's order by Marconi's Wireless Telegraph Co., Ltd.

The control tower (fig. 1) of the new building is 80 ft. above ground, and affords an uninterrupted view of the aerodrome on all sides. On the top floor the radio room is surrounded by glass partitions to divide it from the rest of the floor, which is occupied by the traffic officer. The wireless officer is in control of the receiver and direction-finder, and also operates three of the four transmitters at Mitcham, some 2½ miles from the aerodrome: one of the transmitters is used for telephony on 900 metres, the second one for telegraphy, and the third one is a spare; the fourth transmitter is controlled from a separate route-traffic wireless room. It is intended to adopt in the near future a second wave-length (in the neighbourhood of 1,500 metres) for telegraphy, thus leaving the 900-m. wave free for telephony. As all the transmitters can work on any wave-length between 800 and 2,000 metres, a change in wave-length is simply a matter of adjustment. Some distance from the control tower is a separate wireless room with a separate 200-ft. long horizontal aerial, where reception and transmission take place on 1,400 metres, mainly with other aerodromes, for the exchange of route-traffic messages dealing with the departure of aircraft, and other service matters. The wireless officers in the control tower and in the route-traffic office work independently of each other, and no interference is possible between these two offices.

The aerial system consists of a mast 54 ft. in height on the roof of the control tower, fig. 1, supporting a Marconi-Bellini-Tosi aerial made of two double triangular loops at right angles to each other. The length of the inclined limbs of the loops is approximately 60 ft.; the horizontal limbs measure 30 ft., and are attached at their corners to metal spacing supports which project 15 ft. over the four corners of the roof. From the centre mast is also suspended a phasing aerial 100 ft. long, attached at its other end to the top of the dome of the main entrance hall of the aerodrome terminal building. This aerial and the four ends of the direction-finding aerial enter the receiver room, situated under the roof, through porcelain insulators.

The receiving and direction-finding gear consists of a radio-goniometer unit, used to determine the bearings of aircraft in flight, which is coupled to a Marconi type Rg 14 multi-way directional receiver of continuous-wave telephony and interrupted-continuous-wave signals on any wave-length between 800 and 2,000 metres. The instrument makes use of the "figure-of-eight" method for reception, or the "heart-shape" method for direction-finding, and it may also be used for the reception of all-round signals; all tuning controls, valves, &c., are mounted vertically on a metal panel. A special feature is an arrangement which makes it possible to work more than one direction-finder and receiver on the same aerial system. A double radio-goniometer, a system of anti-coupling, and a dummy aerial, which are necessary to achieve this object, have been provided, so that when traffic conditions require a second and third receiver, they may be installed without alteration to the present receiving gear.

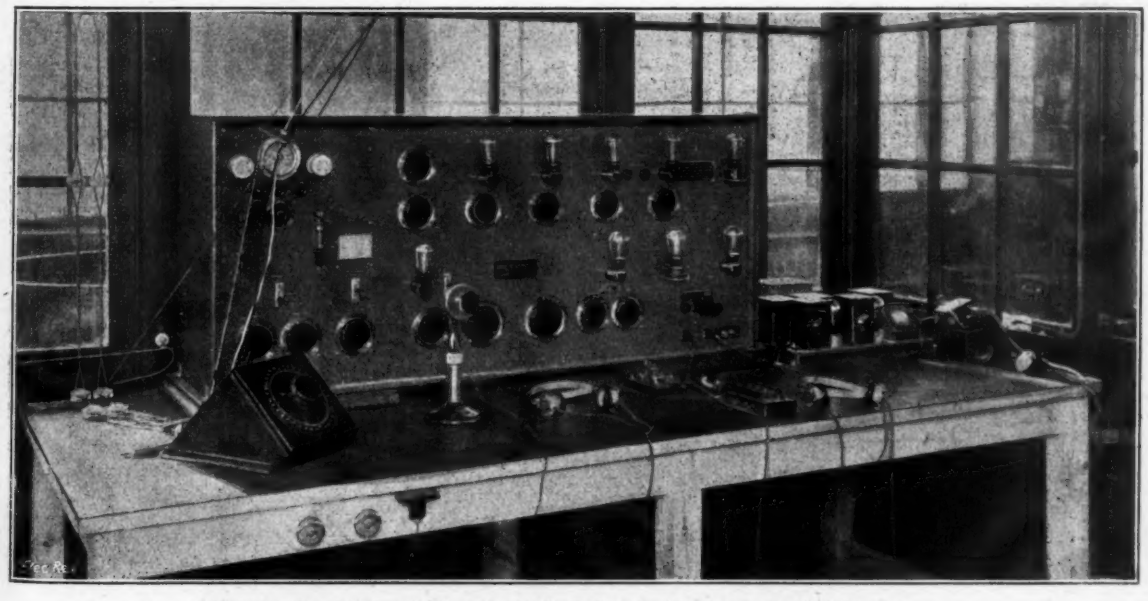
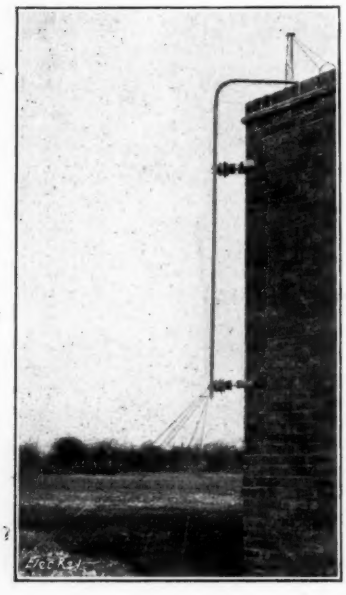
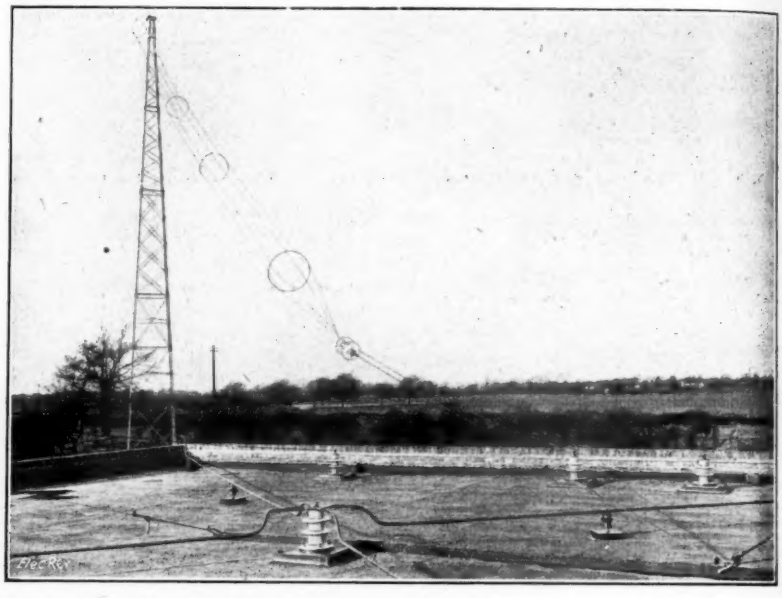


Fig. 2.—Receiving and Direction-finding Gear in Aerodrome Control Tower.

All the receiving instruments and control gear (fig. 2) are mounted on one table: in the centre is the Rg 14 directional

receiver; to the left of the amplifier the radio-goniometer unit is let into the table, with the top of the instrument slanting for comfortably working the search coil: in front are a Morse key and change-over switch, which allow telephony or telegraphy to be used, and to the right is the two-valve line amplifier which magnifies the microphone current when telephony is used; beside the socket into which the microphone is plugged is a tumbler switch which automatically switches on the power the distant transmitting station and another switch which is closed when telephony is transmitted.





Figs. 3 and 4.—Method of Earthing Transmitting Plant.

the bearing of the aircraft. When the pilot of an aeroplane sends a request to Croydon for his position, Pulham and Lympne (at which stations a constant watch is kept) simultaneously take his bearings and transmit them to Croydon by wireless, where (together with Croydon's bearings) they are plotted on a large map; the point on the map where the three bearings cross is the position of the aeroplane, and this reading is communicated from Croydon to the aeroplane. The whole process is accomplished in less than one minute.

The search coil of the radio-goniometer is coupled to an intermediate tuning circuit in the receiver amplifier, which is tuned by a calibrated condenser in the receiver. This circuit is coupled to four stages of high-frequency amplification, each circuit having one DEH.612 valve. The grid circuits are tuned by means of calibrated condensers, which can be imme-

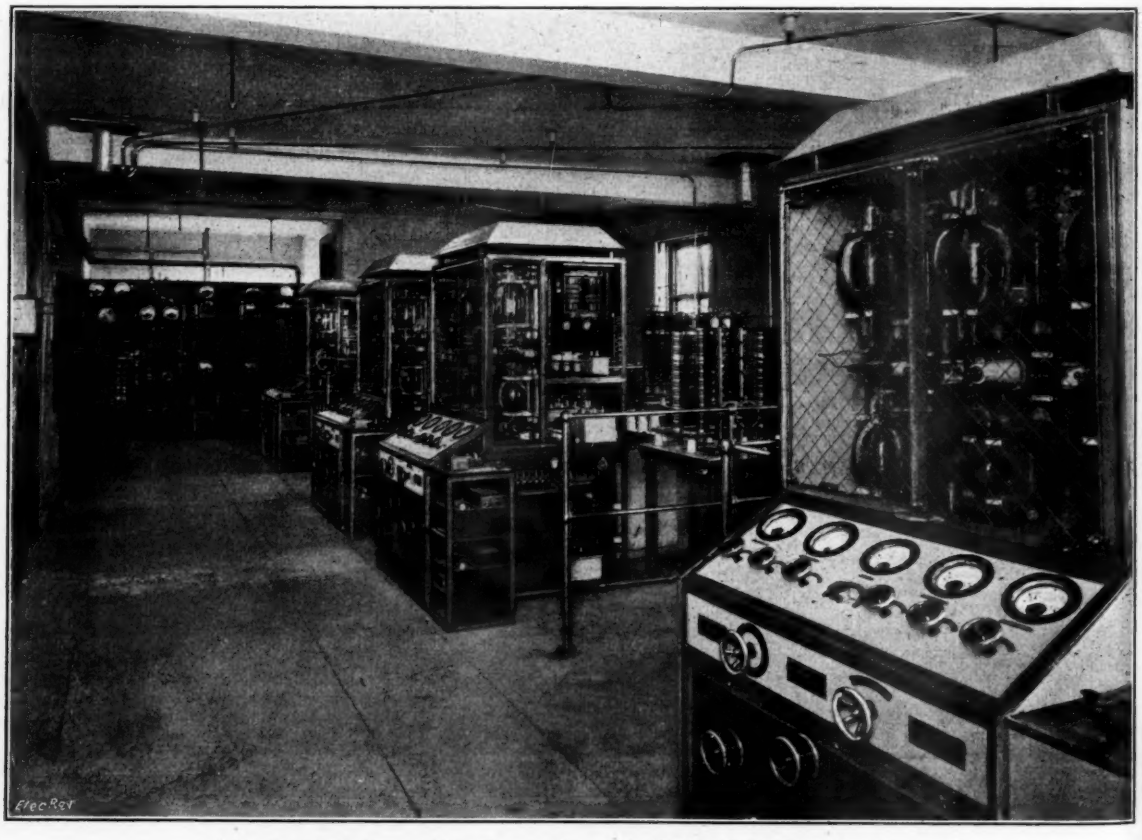


Fig. 5.—Main Transmitter Room, Power Switchboard in Background.

The four terminal wires of the d.f. aerials are connected to two pairs of fixed coils of the radio-goniometer, inside which a moving coil rotates; with the aid of a scale, knob, and pointer on top of the instrument two minimum readings are found, the intermediate reading between them indicating

diately set to any desired wave-length between 800 and 2,000 metres; they are linked to a single control handle which allows the condensers to be varied simultaneously, so that a search can be made over a band of wave-lengths limited to about 10 per cent. on either side of the wave-length to which the condensers are set. This feature enables the operator to locate, without trouble, signals which are not exactly tuned to the normal 900-metre wave. The amplified high-frequency signals are detected by a DEH.612 valve and then amplified by two transformer-coupled low-frequency DEL.612 valves; this magnification may be cut out, or either one or two stages used at will. A local DEL.612 valve oscillation generator specially calibrated in wave-lengths around 900 metres, in addition to the normal calibration dial, may be switched into circuit for the reception of continuous-wave telegraphy throughout the range of the receiver, a variable coupling enabling the intensity to be varied. A further phasing circuit with one DEH.612 valve is used to combine the actions of the open and d.f. aerials, thus providing "heart shape" polar diagram reception. The switch that brings this circuit into action has two other positions: in one the vertical aerial alone is used, and provides "all round" reception, the third position bringing into action the d.f. loops only for "figure of eight" reception.

The filaments of the valves are energised by a 6-volt 100-ampere-hour Exide battery, and the anodes by a 120-volt, 5,000-milli-ampere-hour Exide battery, which are duplicated and charged by a B.T.-H. "Tungar" rectifier which converts the 220-volt a.c. 50-cycle mains supply into d.c. at 6-volt 4 amperes and 120 volts 0.5 ampere.

In the receiving room is a telephone plug board with 10 pairs of lines: four pairs can be used to switch on the power of any of the four transmitters at Mitcham, one pair for each transmitter; four other pairs can be used for speech and telegraph control for any of the four transmitters; one pair of lines is provided for ordinary service telephone communication between the control and the transmitting buildings, and the last pair is for the Post Office telephone.

The transmitting station has been built on Mitcham Common, 2¼ miles from the aerodrome, so that the four transmitters can be worked simultaneously without interfering with reception and obstructing aeroplanes by the masts. From four lattice masts, each 100 ft. in height and placed at a corner of the 250-ft. square site, are suspended four identical aerials of the inverted "L" type, each horizontal limb measuring 145 ft.; of the four-wire cage type spaced on light metal 3-ft. diameter hoops, they are made up of 7/19 gauge phosphor-bronze wire. The four down-leads are connected to four lead-in insulators on the roof of the building, which is located in the centre of the site, in a row along one of the walls (fig. 4) above the tuning inductances.

The earthing arrangement is unusual: a continuous ring of overlapping zinc plates measuring 6 by 3 ft. is buried vertically in the ground around the building; from this ring 20 wires buried in the earth radiate towards the sides of the station site, each wire being connected at its far end to a zinc plate 6 by 3 ft. buried vertically in the ground. Connection from the earth end of the aerial-tuning inductances to the zinc earth ring is made in the following manner: four copper tubes rise from each of the inductances to within a few inches of the ceiling, which they skirt, as shown in fig. 5, and are connected to a copper plate fitted exactly in the centre of the ceiling and connected to a brass rod which passes through a porcelain insulator in the roof; from the top four brass tubes radiate to the four corners of the building and then down vertically, as shown in figs. 3 and 4, being each then connected to the earth ring by eight wires spread out in the shape of a fan. The aerial-earth system is highly efficient, and the total resistance on the 900-metre wave-length is as low as 6 ohms. A short lead in a trench under the floor connected to a plate buried outside the building serves as a separate earth for the machine frames and the metal frames of the transmitters.

The transmitting room (fig. 5) contains the main switchboard and four Marconi 3-kW transmitters, cables and wiring being concealed in trenches in the floor. Behind the transmitters stand the inductances on tables, guarded by metal railings and a collapsible safety gate which, when opened, automatically switches off the power. Each transmitter has seven valves, as follows: one MT 2 main oscillator, two MT 7B modulators, one MT 4B sub-modulator, two MR 6 rectifiers, and one MT 4 drive valve. The sub-modulator is resistance-capacity coupled to the grids of the two main modulator valves, speech being effected by the choke, or constant-current, control method, which is favoured for its purity. The drive valve is totally enclosed with its attendant circuit in a screened box in the lower part of the transmitter, fig. 5. For continuous-wave working the speech choke is short-circuited, the sub-modulator valve is left out of circuit, and the two modulating valves are used as absorbers when the Morse key is in the "spacing" position. For interrupted-continuous-wave signalling a small motor-driven interrupter disk is connected in series with the key, and carries out similar operations, but at an audible frequency, whenever the key is pressed.

The plate potential can be regulated between the limits of 5,000 and 10,000 volts, resistances in the anode circuits of the drive and sub-modulator valves keeping the voltage to the required limits. Controlled from the main switchboard, power at 350 volts, 300 cycles is stepped up through a transformer, rectified by the two valves, and smoothed by condensers and a smoothing choke. Energy from the same source is stepped down by three transformers to different voltages between 12 and 17 V for lighting the filaments, the current for which is not rectified. Beside each transmitter is a small table, on which is a power switch, a Morse key and microphone-plug socket, and a change-over switch for selecting telephony, c.w., or i.c.w., to enable each transmitter to be tested locally. On shelves underneath the tables are 90-volt grid negative batteries for the sub-modulator and 180-volt grid negative batteries for the main modulator valves.

The machine-room switchboard is by Erskine Heap & Co., Ltd.; the incoming supply enters the building at 440 volts, three-phase, 50 cycles, and drives two 15-kVA motor-alternator exciter sets (Newton Bros., Ltd.), either of which may feed the four transmitters, the other being a spare. A prime mover coupled to a generator of similar output has also been installed as a stand-by. The motor-alternators are controlled by Brookhirst pillar starters, and consist of a motor driving a 43-ampere, 350-volt, 300-cycle alternator and a 60-ampere, 40/60-volt exciter for excitation, running relays, and for general d.c. purposes. One phase at 220 volts of the main supply is used for lighting the building. From the machine-room cables run in trenches to the switchboard (Harland Engineering Co.) in the transmitting room, which feeds the valves, and to two grid-bias machines for the absorber and magnifier valves, one being a spare. Made by Newton Bros., Ltd., their 1-kW, 660-volt, d.c. generators are driven by three-phase motors, each with its own starting pillar (Electrical Apparatus Co., Ltd.). The transmitters are brought into action, either locally or along the line from the wireless room in the control tower at the aerodrome. An ingenious arrangement makes it impossible to prepare the valves for power before the filaments are lit, or to extinguish them before the relay is ready to take off the power, thus making it impossible to damage the transmitting valves by not observing the correct order of switching. The valves remain constantly alight, not being switched off like the power; the reason for this is that the continual switching on and off tends to shorten their lives, and it is less harmful to keep the valves alight all the time.

Large E H.P. Transformers.

The Metropolitan-Vickers Electrical Co., Ltd., has recently secured orders for some large very-high-pressure transformer equipment.

IN addition to the large order received by the Metropolitan-Vickers Electrical Co., Ltd., for transformers for the Central Scotland section of the national electricity scheme, a number of other important contracts have recently been placed with this company for transformers of large size, and for extra-high voltages.

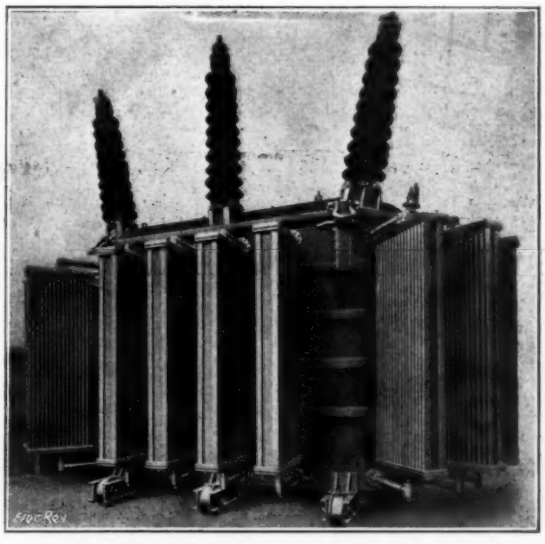


Fig. 1.—4,500-kVA, 132,000-V Three-phase Outdoor Transformer.

Notable in respect of high-voltage apparatus are further transformers ordered for the 132,000-volt Witbank transmission system of the Victoria Falls and Transvaal Power Company of South Africa, for which a large amount of outdoor transformer equipment and switchgear has already been supplied. The further equipment now ordered consists of a 22,000-kVA three-phase bank for the 132,000-V transmission lines, together with a 23,500-kVA three-phase bank and ten

1,350-kVA three-phase units for lower voltages. Figs. 1 and 2 show 132,000-volt transformers already supplied to the Victoria Falls Company. The extensions will bring the total of the M.V. transformers supplied for this system to over 320,000 kVA, of which about 200,000 kVA represents the total of transformers actually supplied for the 132,000-volt transmission lines.

Further apparatus for 110,000 volts and 66,000 volts is on order for New Zealand. The new 110,000-volt transformers are four 10,000-kVA single-phase units to constitute a 30,000-kVA three-phase bank, with a spare unit, for the Penrose sub-station, near Auckland. A feature of interest in connection with these transformers, in view of their capacity, is that they will be arranged for self cooling. The 66,000-volt apparatus constitutes one 12,000-kVA bank and one 7,500-kVA bank of single-phase units for the transmission lines between the Lake Coleridge generating station and Dunedin. Fig. 3 shows a large 110,000-volt single-phase unit ready for dispatch to New Zealand. Six units of this size, constituting two 20,000-kVA three-phase banks, will form the main step-up transformer equipment of the new Waikaremoana hydro-electric power station, for which the initial generating plant is also being supplied by the Metropolitan-Vickers Company. Other orders which are at present being carried out by the same company for New Zealand include over 250 transformers, ranging from 1½ to 1,000 kVA. for various parts of the Government systems.

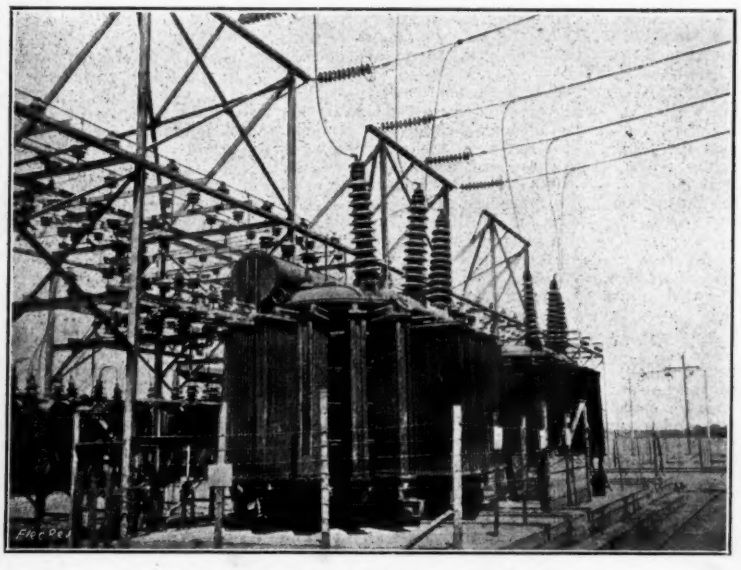


Fig. 2.—132,000-V Transformer in Service.

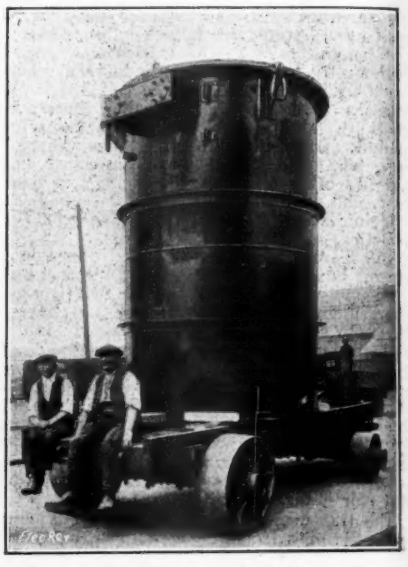


Fig. 3.—110,000-V Single-phase Unit Ready for Dispatch.

In respect of large capacity transformers, one of the most notable recent contracts is for two 43,750-kVA and two 33,000-kVA banks ordered by the London Power Company. These transformers are for the new Deptford West power station, for which the M.V. Company is also supplying two 35,000-kW turbo-alternator sets. The transformers will be in single-phase forced-cooled units, with a spare to each bank, and will be designed to step-up the generating pressure from 11,000 to 22,000 volts for transmission to sub-stations on the system.

Electrical Precipitation.

An outline of the process and some descriptive notes of various electrical gas-cleaning installations.

By A. GROUNDS, B.Sc., and H. W. C. HENDERSON, A.R.C.S.

(*Abstract of a paper read before the* SOUTH WALES INSTITUTE OF ENGINEERS *and reproduced in the Institute Proceedings.*)

FOR all practical purposes electrical precipitation, as we now understand it, dates from the researches carried out by Sir Oliver, then Professor, Lodge, at Liverpool in 1884. The year 1906 saw the beginning of the work in America, when Dr. F. G. Cottrell carried out investigations in that country. To-day, as the result of co-operation, Messrs. Lodge-Cottrell, Ltd., are operating the electrical precipitation process.

In general, the Lodge-Cottrell apparatus takes one of two forms which embody the same principles, and differ only in the nature of the electrodes used. The first form of apparatus, the *plate-type treater*, consists of a number of vertical plates which form the collecting electrodes, and a system of wires hanging equidistant between the plates and constituting the discharge electrodes. In practice the plates are earthed, while the wires are suspended from insulators and charged with high-pressure current. The gases to be cleaned pass between the wires and the earthed plates, and are there subjected to the electric discharge which takes place across their path. In the second form of the plant, the *pipe treater*, the collecting electrodes comprise a number of earthed metallic tubes, down the axes of which wires are suspended from suitable insulators above. The gases are led through the tubes either in an upward or a downward direction, and the suspended matter is precipitated on to the inside surface of them through the action of the electric discharge.

Each type of treater is designed to meet the special conditions under which it will have to operate, and it is possible, given sufficient data, to design the correct type and size of plant to meet the particular need and obtain the maximum efficiency. Numerous difficulties encountered with the early plants have been overcome, and practically any fume can be dealt with. Suitable hand or mechanically operated rapping gear is provided for vibrating the electrodes from time to time, so as to dislodge the dust accumulated on them. The dust then falls into hoppers or conveyors arranged below. This rapping operation only takes a minute or two, and is not generally needed more often than once in every three or four hours.

An interesting phenomenon connected with the deposit of dust on the electrodes is observed under certain special conditions. Although the collecting electrodes are earthed, a layer of dust on their surface, if perfectly dry and of a non-conductive nature, may sometimes cause a charge of electricity to accumulate, and *back-ionisation* is the result. This is an *opposing* discharge which takes place from the layer of dust on the surface of the earthed electrode, and the ionised gas caused by such discharge offers an easier path for the current, thus again virtually lessening the effective distance between the two electrodes and making it impossible to maintain the maximum difference of potential between them. This difficulty can, however, be overcome quite readily in practice.

When the suspended particles are in liquid form, the liquid trickles down the electrodes and is collected in a sump or led away.

The current supplied to the discharge electrodes of a precipitator is unidirectional and usually at about 50,000 or 60,000 V. The h.p. equipment is protected by approved screening devices,

and there is no danger whatever to workmen engaged in operating the apparatus. The necessary electrical equipment includes a special step-up transformer; a mechanical rectifier, in the form of a rotating switch; control and regulating gear; and automatic safety appliances. The rectifier is either driven by a small synchronous motor or is mounted on the same shaft as a small motor-generator set. The current consumption and maintenance of even the largest installation is a small item. A standard Lodge-Cottrell rectifier unit, driven by a 1½-h.p. synchronous motor, is shown in fig. 1. The h.p. current is delivered from this to the discharge-electrode system, either by transmission lines supported on suitable insulators or by special h.p. cable needing no extra insulation. Automatic indicating devices are employed to show how the units are connected; cut-outs and signal horns operate if special attention is needed, while flexibility of control is achieved by means of a system of h.p. lines and switches arranged overhead.

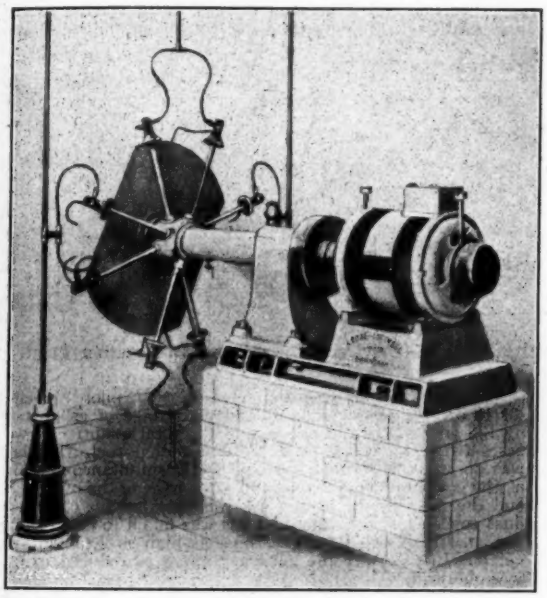


Fig. 1.—H.P. Rectifier Set.

Electrical gas-cleaning installations have been designed to clean the gases to a degree sufficient for their use in stoves and boilers. In four particular installations the cleaning is carried to a point where the exit gases contain from 0.2 to 0.3 grm. per cu. m. An installation for rough-cleaning blast-furnace gas for stoves and boilers has recently been taken into commission at Messrs. Stewarts and Lloyds' works at Corby, near Kettering. This is capable of dealing with a maximum gas volume of 6,000,000 cu. ft. per hour. The plant consists of 12 independent plate-type chambers in parallel, fig. 2, and there are six motor-generator transformer sets for supplying the necessary electrical power. Each chamber has four banks

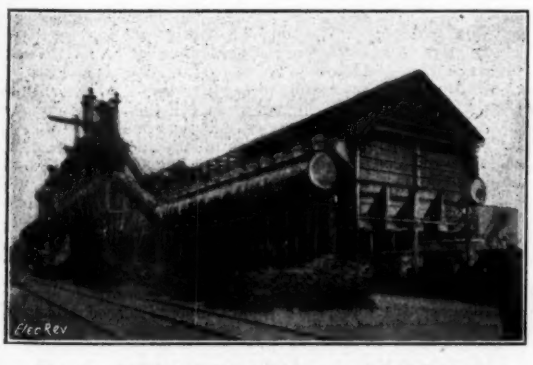


Fig. 2.—Plate-type Blast-furnace-gas Installation.

of electrodes, and the first two and last two banks are operated by separate transformers. The heavier dust particles are caught in the first two hoppers, and the finer fume in the last two. Mechanical rapping gear is provided, and one man controls the whole plant, except the handling of the precipitated dust.

One of the principal fields to which the electrical precipitation process has been applied is the sulphuric-acid industry. Where pyrites or spent oxide is burnt there is always the problem of dealing with the fine dust particles carried over by the draught on the furnaces, and efficient cleaning of the hot gases becomes a very important feature of the process. Fig. 3 shows a Lodge-Cottrell chamber for cleaning pyrites-burner gases at a temperature of about 500 deg. C. Electrical precipitation is also applied to the collection of sulphuric acid fumes arising, *e.g.*, from concentrators, or from the parting kettles used in such operations as bullion refining.

At the National Smelting Company's Works in South Wales a plate-type precipitator treats the hot gases from a Delplace roasting installation. The roasters burn on an average 21 tons of raw zinc blende per day, and the precipitated material is chiefly lead sulphate, of which about 12 cwt. a day is collected. Since this material is precipitated in a dry state and is not discoloured, it is a readily saleable product. The volume of gas dealt with in the dust collector is approximately 360,000 cu. ft. per hour.

At Rothschild's gold and silver refinery at the Royal Mint, a small 12-pipe treater is installed for collecting the precious metal fumes from refining furnaces. The process worked depends for its success upon efficient fume recovery, and in this instance the efficiency is practically 100 per cent. The copper-

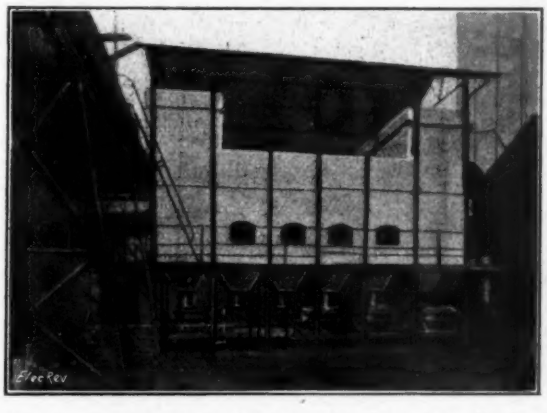


Fig. 3.—Precipitator for Dealing with Gases from Pyrites Burners.

oxide which forms the bulk of the collected material contains 5 per cent. silver and 5 per cent. gold.

Lead oxide is extracted from the flue gases from two blast-furnaces at the Newcastle works of Messrs. Walkers, Parker, Ltd., by the plant shown in fig. 4. This consists of two sections of 72 pipes each, the furnace gases passing down the pipes in one section and up those in the other. Continuous rapping gear, worked by a small motor, dislodges the material from the discharge electrodes, while hand-operated rapping hammers are arranged outside the pipes for vibrating them occasionally to clear the precipitated dust deposited on their inside surface. The dust falls into large boxes arranged underneath, and by allowing it to burn there when any one chamber is opened up for cleaning, it automatically sinters and

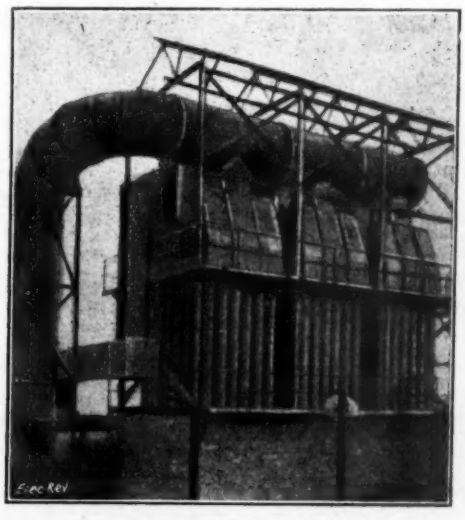


Fig. 4.—Pipe-type Precipitators for Lead-oxide Extraction.

is then very easily handled. In this form the material is returned direct to the blast furnace.

The cement industry is another direction in which the electrical-precipitation process has proved of practical importance. The first installation of this kind in connection with cement manufacture was made in 1913 at the Riverside Portland Cement Co., of California, where nearly one million cu. ft. of

gas per min. are treated at a temperature varying between 350 and 500 deg. C. The main part of this installation is of the plate type, but the gases from two kinds of kilns are treated in a pipe precipitator, fig. 5, which handles 100,000 cu. ft. per min. at 350 deg. C., and consists of 480 vertical pipes 10 ft. long by 12 in. diameter. The dust collected is a high-grade potash material, and about 3½ tons of it are collected per 24 hours.

A successful effort in the direction of solving the smoke-abatement problem has recently been made by the Research Corporation of New York at the Trenton Channel Station of

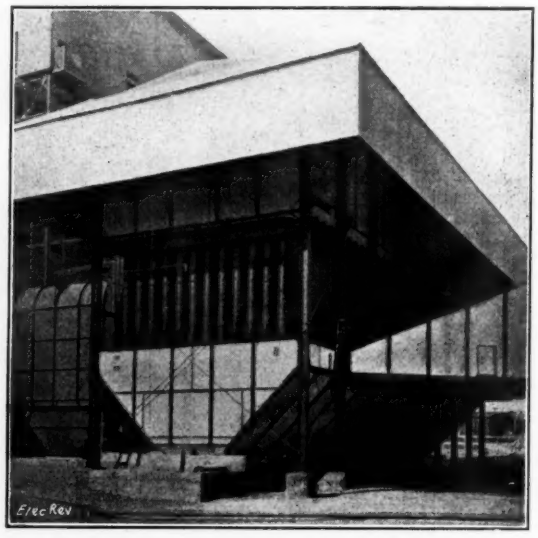


Fig. 5.—Part of Cement-works Installation.

the Detroit Edison Company. The power plant is being fully equipped with eight electrical gas cleaners, serving four stacks discharging gas from eleven boilers. The gas volume, corresponding to 200,000 kW, handled by the electrical precipitators is between one and a half and two million cu. ft. per min. The gas from three boilers enters one stack and passes through two precipitators. Before reaching the precipitators the gas has passed through economisers, so that its temperature in the electrical cleaners is from 350 deg. to 400 deg. F. Each stack discharges up to about 1,800,000 lb. per hour. Carried in suspension in this volume of gas is the ash from the burning of the powdered coal, and it is estimated that from 60 to 90 per cent. of the total ash is suspended in the gas after it leaves the economisers. Tests made on the gas at the precipitator inlet show an average dust concentration of 2.3 grains per cu. ft.

The "collecting" electrodes consist of concrete plates 2 in. thick, having reinforcing rods arranged at regular intervals. It has been found that for some kinds of dust a semi-conducting electrode of the kind employed at Trenton Channel is more suitable than the usual metallic plate, and that the operation of the precipitator is normal in spite of an accumulation of dust on the plates.

A metal housing covers and protects the entire unit. Air is drawn through louvres in the housing by ventilating fans and is circulated to the top of the boiler house to prevent excessive heating of the precipitator structure, whilst in winter the upper portion of the housing is kept warm enough to avoid condensation in the pulverised-coal conveying piping. A series

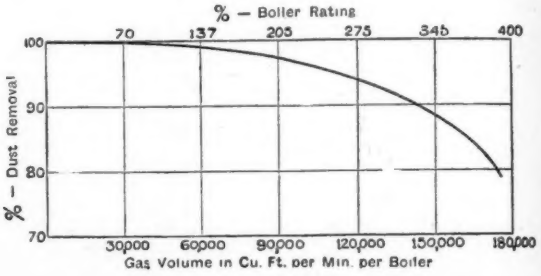


Fig. 6.—Efficiency Curve for Power-station Plant.

of performance tests was conducted on the "pilot" precipitator to determine the amount and percentage of ash removed by the apparatus from one-half of the total quantity of waste gases from one boiler fired with powdered fuel. The boiler was operated at various ratings, while simultaneous samples of the gas were taken before and after passing the precipitator, and the ash content of the gas was calculated. The average dust concentration in the inlet gas was found to be 2.31 grains per cu. ft., though it was at times as high as 4.45 grains per cu. ft. In this way the efficiency curve reproduced in fig. 6 was obtained.

The average quantity of material collected is about 14 tons per day per boiler. The dust drops into hoppers below the apparatus, from which it flows through sluicing troughs in the basement of the boiler house.

Registered Electrical Contractors.

Annual Report and Meeting of the National Register.

THE report of the Executive Committee of the National Register of Electrical Installation Contractors for the year ended December 31st last states that the position is considered satisfactory. The foreshadowed expenditure on special publicity does not appear in the accounts, as the Committee was unable, for the time being, to conduct the special campaign. During the year 191 applications for registration were received; of these 101 were accepted, 44 were declined, and 46 remained under investigation. The total number of applications received up to the end of 1927 was 1,348, and 1,177 had been accepted. For various reasons 79 registrations had been cancelled—only two for bad workmanship—leaving a net number of 1,049 on the Register. Since the close of the year, up to March 9th, there has been a net addition of 17. While the number of applications received in 1927 was smaller, the number declined was larger, indicating that the "more eligible" contractors have already been admitted. There are still a few firms of high standing which have not yet become registered, and the Committee hopes that they will realise that it is a duty which they owe to the industry to do so. Increasing interest in registration has been shown by supply authorities, particularly those with assisted wiring schemes, and many of them have restricted their installation work to registered contractors. Others are prepared to do the same if a sufficient number of local contractors become registered. An addition is being made to the Local Advisory Committees by the formation of one for Truro, covering Falmouth, Penzance, and the surrounding district. The proposed re-arrangement of the areas of the London Local Advisory Committees has been carefully gone into, and it has been decided to form smaller areas involving an addition of 12 to the existing 5 committees in the London area. This is expected to result in the expedition of reports and a saving of time generally. The standing order relating to the constitution of Local Advisory Committees is to be revised to preclude the nomination of unregistered contractors. The Committee expresses thanks to the members of the Scrutinising Committee, Messrs. Cash & Purse, for their excellent work. A definition of the term "suitable business premises" has been drawn up and circulated to all members of Local Advisory Committees. In consequence of suggestions that unsuitable persons were being registered to the detriment of the success of the Register, a meeting of the Registration Board and Local Advisory Committees was held in January last in order that the subject could be discussed. While certain representatives of the English contractors expressed the view that additional qualifications were desirable, they were unable to agree as to the nature of these. On the other hand, the Scottish contractors were unanimously agreed that there should be no "tightening up" in the qualification conditions. The Executive Committee has, however, made an alteration in the form of application which will lead to the disclosure of more information than before. The report refers to criticisms of the Register which have appeared in the technical Press and elsewhere, and states that "it would seem very little is called for in the direction of meeting these criticisms, as they appear to be based on the assumption that the National Register is a trade organisation, and that contractors, when they become registered, acquire the rights of members of such a body, and are entitled to require the Register to be conducted with this object in view. This is not the case. As the members of the Registration Board are aware, the National Register exists primarily for the purpose of protecting the public. It is true that in so doing it serves the interests of those contractors who are registered, but it is

obvious that to conduct the National Register purely in the interests of registered contractors (which is what all these criticisms amount to) would not only detract from the standing of the National Register, but be at variance with its constitution, and lead to strong objection on the part of the founding bodies." The report proceeds to state that no complaints of bad workmanship were lodged during the year; 20 contractors were removed from the Register owing to financial failure, and one who had been granted temporary registration failed to acquire the necessary business premises within the prescribed time. An injunction was obtained against a firm of contractors who were found to be illegally employing the device of the Register. The Committee expresses the view that the time for a move towards the adoption of wiring rules has not yet arrived. The Committee refers with regret to the death of Mr. Leon Gaster, and states that his place on the board as representative of the Illuminating Engineering Society has been taken by Mr. J. S. Dow. The other bodies have nominated their retiring representatives to continue their representation on the board. The report concludes with an expression of thanks to the chairman, Mr. P. V. Hunter.

The accounts show an excess of income over expenditure of £603 (against £708 in 1926). The total expenditure was about £1 2.0, of which £84 was accounted for by advertising and publicity literature.

The Annual Meeting.

The annual meeting of the Register was held at the Institution of Electrical Engineers on Monday last, Mr. P. V. Hunter (chairman) presiding.

After the reading and adoption of the report and the confirmation of the re-nomination of members of the Board, Messrs. P. V. Hunter and A. H. Dykes were re-elected chairman and vice-chairman respectively.

Amendments to the rules and conditions of registration were then considered. Among these is one requiring applicants to possess suitable business premises (a definition of which has been circulated to local committees). A new qualification clause permits an applicant to have at least one year as a contractor and, in addition, sufficient service as a supervisor or foreman to make up five consecutive years. Another addition requires the applicant to permit inspection of past or current work. Dies and blocks of the registration device are to remain the property of the Register, to be returned upon the cancellation of the registration. The Executive Committee is empowered to restore a contractor's name to the register after removal for any cause, if it thinks fit to do so. The use of inferior material is to be a ground for withdrawing the certificate, as well as bad workmanship. All the amendments were approved.

Mr. W. Cross considered that the local committees should be given a proper definition of the term "installation contractor" by the Executive, but Mr. F. W. Purse pointed out the difficulty of applying the same definition in, say, Manchester and a small country town. The latter also said that an honest endeavour had been made to meet all points of view, and the criticisms to which they had been subjected should be satisfied. Mr. W. A. Shaw thought that the criticisms were effectively dealt with in the report.

The next business was the consideration of variations of the standing order relating to the constitution of Local Advisory Committees. The main aim was to ensure that the Electrical Contractors' Association should not appoint unregistered members to local committees. Mr. Purse said that in one case not only was the nominee unregistered, but his application for registration had been declined. Mr. W. A. Shaw (president of the E.C.A.) said that it would be preferable to refer the matter to the E.C.A. before adopting the amendments. It was unfortunate that a number of the Association's members were not registered; he thought that reference of the question to the E.C.A. would be for the good of the Register. Mr. Cross said that sometimes the E.C.A. was asked to nominate a member for a Local Advisory Committee in a district in which registration was weak, and the Association was compelled to appoint a man who was known to it, whether he was registered or not. Such a man would no doubt soon become registered, but he thought that the matter should be left to the discretion of the E.C.A He also thought that giving the I.M.E.A. power to nominate members to committees in districts where the supply undertaking was municipal would at times work unfairly. To meet that point it was decided that the nominating body should be the authorised undertaker for the district. Mr. H. J. Cash said that it would perhaps be advisable to hold a joint meeting of the Executive and the E.C.A. Mr. W. R. Rawlings moved a resolution that the Executive Committee should be given full powers to act after obtaining the views of the E.C.A. This was seconded by Mr. A. R. Roberts (B.E.A.M.A.), and carried.

Mr. Shaw said that a great deal about publicity had appeared in the Press. He considered that individual contractors could do a great deal, particularly by using the cards which were provided by the Register. Mr. Purse said that the cards were always available to those who asked for them. A campaign had been discussed with Mr. J. W. Beauchamp, but upon his resignation as director of the British Electrical Development Association the matter was left in abeyance. Other publicity methods were being considered.

The meeting concluded with votes of thanks to the chairman and the Scrutinising Committee, Messrs. Purse and Cash.

Reviews.

Measurement of Air Flow. By E. OWER. Pp. vii+199; figs. 73. London: Chapman & Hall, Ltd. Price 15s. net.

This book will be of value to engineers dealing with ventilating problems, with gas flow, and, to a certain degree, to those dealing with compressed-air work. The most interesting chapter is the one dealing exhaustively with vane anemometers; other illuminating chapters relate to orifice plates, nozzles, Venturi tubes, Pitot tubes, and manometers. The last chapter treats of hot-wire anemometers, but the fullest treatment is given to Pitot tubes, anemometers, and manometers. The author has found that air measurements frequently present serious practical difficulties to engineers and fan manufacturers and users. This book was written to fill a gap in the literature of the subject, and does worthily fill it. The reviewer has two main criticisms to make; the first is that owing to the choice of one symbol, *e.g.*, R, to represent different things at different times, the matter is less readily intelligible than it might have been; the second, which is purely a matter of opinion, is that the author seems to use long algebraic expressions instead of using differential calculus direct. In dealing with air flow a good deal of mathematics must be used, and it is easiest to use differential equations. The reader who does not know differential equations will hardly have patience to dig through the algebra.

There is not the slightest doubt that the book is a valuable one, and the following remarks refer to places where perhaps there are ambiguities. The reviewer noticed only one obvious printer's error (p. 13, line 13), notwithstanding the mass of equations which exist. The note on p. 6 states that the effect of density will be neglected; but seeing that compressed air might be measured, it is considered that the density might have always appeared in equations; if ρ_1 is the same as ρ_2 this can be allowed for at the end. The author calls ρ the "density," and puts it for "weight per unit volume divided by g"; that is not the density. Density is "mass per unit volume," the unit of mass being 1 lb. or 1 gramme; the density of air is 0.0737 lb./ft.^{3} at normal temperature and pressure. On p. 56 this symbol ρ is lb./ft.^{3} divided by g, and for air it is said ρ=0.00237; the quantity ρ is called "Slugs per cubic foot," a most unusual term. [Prof. Perry used this expression, we believe, as a unit of mass (=weight/g), in dynamical problems.—EDS.]

The use of ρ instead of m, the real density in lb./ft.^{3}, or gm./cm.^{3}, converts the very common term $mv^2/(2g)$ into $\frac{1}{2}\rho v^2$, which is not so well known. As the author is dealing with flow of air in pipes, as well as for metering, it might have been better to put equation 1 in the complete form—

$v\,dv+dr/m+dH+dz=0$ where dz is the friction term.

Then if the fluid is frictionless dz=0. This equation could be used to deduce Eq. 2 on p. 38, and equations on p. 141-144.

In a few cases the wording is unsatisfactory. Consider p. 47: "the resistance is equal to the difference between the mean energy of unit volume," and p. 48, "the total heads, &c., their difference will be the resistance." This is not so. Resistance is not energy. The work done in overcoming the resistance will cause the loss of energy, and can be measured by the difference in total head. Curves on p. 60 show coefficients c_1 and c_2 up to values of temperature 2,000 deg. F., but do the equations hold for such temperatures? It might have been more useful if the scale for the range of values 0 to 300 deg. F. had been about 6 inches instead of 1 inch, and the values above 400 deg. F. had been left out.

The use of one symbol for many different quantities makes equations more troublesome to follow and appreciate than need be. For instance, R is used for pressure on pp. 12, 38; for radius on p. 45; for a_1/a_2 on p. 71; for gear ratio on p. 117; and for electrical resistance p. 174. It should be kept for radii and for resistance. Then on p. 111, C is called a gearing constant, where surely it should be instrument constant; gearing constant would be n/N.

The treatment of flow through an orifice, Case (*a*), p. 69, is ambiguous. Equation 5 may be correct, but the author's working out, and the use of ρ "slugs per cu. ft." is not satisfying. He takes $\rho=\rho_1=\rho_2$ and then "The weight of air per unit time" $=\rho_2\ a_2\ v_2$; 7 lines lower down, "weight of air flowing per second=$q=g\ \rho_2\ a_2\ v_2$, and, again, 7 lines lower down, states in certain terms what is equivalent to "actual weight of air flowing per second, $q=g\ a\ \rho_2\ a_2\ v_2$. It is not easy to see how equation (2a) is true if equation (5) is true. The reason for the peculiarity is partly explained by the author, when he says that the air does not fill the whole area a_2, but fills the vena contracta. This lesser quantity of air is represented by $a\ q$. But the working out is not as clear as it might be.

The bibliography on p. 195, which has only reference to the last chapter, dealing with hot wire anemometry, might have mentioned some of J. S. G. Thomas's work in *Phil. Mag.*, Vol. 39, p. 507; Vol. 42, p. 940; Vol. 43, p. 277; and there are other references as well. One point *re* the setting-up of type might be mentioned: some years ago the London Mathematical Society and printers suggested that fractions such as $\frac{p_2}{p_1}$ in the text should be printed as p_2/p_1, and not in the fractional form. The extra work involved in setting-up the fractional form is well exemplified in p. 79-87.

A.B.E.

Britain's Fuel Problems. Pp. xvi+592; illustrated. London: *The Fuel Economist*. Price £3 3s. net.

The Editor of this book, Mr. Sydney H. North, has attempted a very ambitious task, and, with the aid of his assistant editors and over fifty contributors, has succeeded in producing a unique and valuable addition to the existing literature on the subject of fuel and its utilisation. It may safely be said that in no previous volume has the use of coal and its products been dealt with from so many aspects. We say "coal" and not "fuel" advisedly, because the title of the book is rather misleading. Since the consumption of petroleum in the United Kingdom approaches three million tons per annum, it cannot be denied that it is an important factor in our fuel problems. It therefore seems a pity that more space has not been given to the synthesis of fuel oils and spirits by hydrogenation and other recently developed methods of treating coal. Although these processes are at present hardly beyond the experimental stage, they may become of immense importance, since we have no natural supplies of oil. Similarly we should have expected some space to be devoted to the production of oil from shale; it is possible that this industry may be revived at some future date.

The various chapters are written by well-known authorities, but it must, of course, be remembered that it is the privilege of experts to differ; consequently some of the opinions expressed will be disputed. Furthermore, since even experts are human, they have prejudices, and on certain subjects their opinions may not be entirely free from commercial bias. However much latitude may be allowed in the expression of opinions, there is no excuse for errors of fact, and unfortunately there are one or two instances of this which will be referred to later.

There are four introductory articles reviewing briefly the present position of the practice in fuel economy in America, France, Germany, and Belgium. The work is then divided up into ten sections of varying length, covering different aspects of the problem as it affects Great Britain.

Part I is devoted to the production of coal, and deals with the characteristics of British coals, loss of coal in mining, and the production and utilisation of power in collieries. Out of a total production of 260 million tons per annum, sixteen million tons of coal are used at the collieries. It is customary to use as far as possible low-grade coal for steam raising, and many collieries are adopting powdered fuel firing, using unsaleable fines below ¼ in. or 1/16 in. mesh.

The preparation of coal is dealt with in Part II, which contains chapters on the cleaning of coal below and above ground and on briquetting. The modern tendency is to raise the coal at minimum expense and remove the increased proportion of refuse by dry or wet cleaning processes at the surface. It is left to a chapter in the next section to explain the importance of removing the adventitious ash before use.

Part III is by far the largest, and is divided into two sections, the first dealing with steam raising and power production, and the second with the utilisation of coal in the iron and steel industries. The section on steam raising, &c., is very comprehensive, and includes important chapters on combustion and coal classification (which overlap somewhat), and chapters on various aspects of steam raising and power distribution. Some of the subjects treated, *e.g.*, water service, utilisation of steam, superheaters, &c., are not fuel problems in the strictest sense, though they do have important effects on fuel consumption. In a chapter on steam raising in ships the author states that "the use of pulverised coal, so far, has been entirely restricted to water-tube boilers. . . ." This is incorrect, for there are several successful installations in England of powdered-coal-fired shell-type boilers, and there are at least four British firms engaged on this work. An American vessel fitted with Scotch boilers has made a successful trip across the Atlantic using powdered coal as fuel. In a chapter on mechanical draught the contributor gives incorrect information regarding the "Prat" system of induced draught, and states that the power consumption is about 65 per cent. in excess of that required by an ordinary induced-draught fan. In a properly designed genuine "Prat" installation the power required is actually appreciably less than for ordinary fans, hence its very extensive adoption by the Birmingham Corporation Electric Supply Department. There is no excuse for the above-mentioned mistakes. There is a section on pulverised fuel which is actually very largely a description of the Lopulco systems. This is unfortunate, as there are several other successful systems deserving of mention, and having important differences from those described. The second section of Part III deals with the heating of blast furnaces and metallurgical furnaces of various types, and includes a chapter on powdered coal in metallurgical work.

High-temperature and low-temperature carbonisation are treated of in Parts IV and V. The questions of metallurgical coke production, coal gas production, and the utilisation of gas and gas-works coke are considered. Low-temperature distillation is discussed with particular regard to the oil and tar derivatives produced. The following section deals with the gasification of coal in gas producers; since the fuel chiefly used in producers in this country is bituminous coal, the subject is treated from this point of view, and the question of by-product recovery is dealt with. A table has been compiled purporting to show the relative capital and operating costs of a modern steam-electric power station when the boilers are fired with producer gas with by-product recovery, mechanical stokers, or powdered coal, and it is contended that the first named is the cheapest method, though it has the highest capital cost.

The remaining four parts are comparatively short, and cover the internal heating of buildings, complete utilisation of fuel energy (comprising five quite irrelevant though useful chapters), refractory materials, and oil power. The last consists of a chapter on oil-fired furnaces and one on the applications of Diesel engines. It offers no suggestions on how we are to obtain adequate supplies of oil fuel without importing them from abroad.

There is also a chapter on submerged combustion, a principle which is now being developed commercially in this country. It offers important advantages in the concentration of corrosive chemical liquors, and may prove to be of considerable value.

At the end of the book there is a descriptive supplement contributed by various manufacturers which gives some quite useful additional technical information on the subjects treated. The book is well illustrated, and it will be seen that it brings together in a single volume data which could only otherwise be obtained by reference to a large number of technical books. There is something in it for everybody who is concerned in any way with the production or utilisation of fuel.

R.H.A.

The Theory and Practice of Radiology. By B. J. Leggett. Illustrated. London: Chapman & Hall, Ltd. Price: Vol. I, 18s. net; Vol. II, 25s. net; Vol. III, 42s. net.

The reviewer of Dr. Bernard J. Leggett's "Theory and Practice of Radiology" is confronted with a formidable task, partly on account of the fact that the work is probably unique in scope and treatment, and partly because few indeed can claim competence over so wide a field as that embraced within the four volumes in question.

These deal respectively with the following departments of the subject. I.—Electrical Theory Applied to Radiology. II.—The Physics and Measurement of X-Radiation. III.—X-Ray Apparatus and Technology. IV.—Diagnostic and Therapeutic Radiology (not yet issued).

The subject-matter is clearly and logically set forth, finely printed, and well indexed in volumes of convenient size. There are, in addition, numerous excellent plates, and many line drawings in the text.

The first volume, as the author indicates, is really a textbook of magnetism and electricity, containing only those portions of the subject of direct interest to the radiologist. Although starting from first principles, it pre-supposes a considerable familiarity with electrical theory in general, and the medical student and practitioner will probably find some revisal of the elements a desirable preliminary to its perusal.

The second volume is concerned with the physics and measurement of X-radiation, and commences with the electromagnetic spectrum and a chapter on certain analogies between X-ray phenomena and those associated with the longer-waved region—the visible spectrum.

X-ray spectroscopy is dealt with briefly, but sufficiently, the author then passing on to the discussion of the properties of X-radiation. The chapters most interesting to the medical radiologist are probably those dealing with the measurement of "quality" and "intensity." The recommendations of various authorities on protection and dosage are given in appendices.

The third volume treats of all the special apparatus which the development of this new science has called into being. Modern high-potential generators and hot-cathode X-ray tubes naturally receive very thorough treatment, and the induction coil and its accessories and the original "gas tube" are described with an adequacy suggesting that the author does not share the view that both are fast becoming, if they are not already, obsolete, owing to the unification of the national electricity supplies on the 50-cycle a.c. system—admirable from the point of view of standardisation, if not from that of results.

Some special reference must be made to the preface, in which the design of the work is explained by the author, who states that he has endeavoured to provide a sound combination of theory, apparatus and practice, and it may be doubted if any critic would seriously question his success. One may ask, however, if the "medical student, doctor, and radiologist" will on the whole seriously endeavour to obtain the "wide knowledge of the physical and electrical principles" which is here advocated. They simply have neither inclination nor time. A certain standard is admittedly indispensable, as the institution of the Diploma in Radiology serves to show, but surely it must be conceded that in the medical profession a sound *medical* knowledge and experience must claim precedence over all else. On the first page of the first chapter of the first volume Dr. Leggett writes as follows:—"The scientific study of electricity is, therefore, urged upon all those intending to specialise in medical radiology, since a specialist should know all that has been already achieved in this connection; and a patient entrusting himself to the care of a specialist has the right to claim such expert knowledge." This surely savours slightly, at least, of exaggeration, as does the later remark that "the modern higher grade engineer is a specialist who has a complete knowledge of physics." The mentality implied in these illustrations no doubt approaches a certain ideal, but practical considerations, unfortunately, demand recognition.

Certain manufacturers of X-ray equipment supply a "book of words" with their installations, and the purchaser is informed that without previous experience he can produce perfect results after having read the book and "pressed the button marked A." It is not difficult to imagine what Dr. Leggett would say regarding such methods, but it may be open to question whether many radiologists, and still less so medical men using X-rays for diagnostic work only, can possibly acquire the medical training indispensable to efficiency, and also, in addition, even the minimum suggested acquaintance with mathematics, engineering, and electricity. Is not the solution of the difficulty rather to be found in the more general adoption of the methods of co-operation which are already by no means unknown, whereby the *group* of specialists necessary to the effective functioning of an X-ray department are duly accorded their appropriate status, and made responsible for their respective duties? The usual alternative to some such arrangement rather tends to ignore the hard logic of facts.

Dr. Leggett concludes his Preface by expressing the hope "that the work will be of value to all doctors and radiologists and will serve as a comprehensive text-book for medical students." This is indeed a modest hope, and it might be suggested rather that the work provides a mine of information for all workers in every branch of the already large and ever-expanding science of radiology.

The originality of treatment and high standard of the first three volumes will naturally cause the fourth to be looked forward to with keen anticipation by the medical radiologist, to whom it will be more particularly addressed.

C.N.K.
J.L.T.

Legal.

Islington Corporation v. Rawlins.

AN unusual case was heard at the Clerkenwell County Court on April 11th, when the Islington Corporation brought an action against William Rawlins claiming the return of an electricity meter or its value and £5 damages for its detention, and asking for a declaration affirming its right to cut off the electricity supply in the circumstances. According to the *Islington Gazette*, counsel for the Corporation said the Corporation did not wish to cut off the supply as the defendant's were business premises, but the conditions of contract had been broken. It was stated in evidence that the meter was damaged and was registering in a manner very favourable to the defendant, but he refused to allow it to be taken away. The defendant had paid his bill regularly and, according to Counsel, there was nothing in the statute which would permit the Corporation to cut off the supply. It was considered, however, that the refusal of the defendant to allow the meter to be removed brought the contract to an end.

Judge BAIRSTOW said that he would not make a declaration that the Corporation was entitled to cut off the supply. He would, however, make a declaration that under the agreement the plaintiffs were entitled to remove the meter, and 20s. damages for breach of the implied condition that the defendant would permit them to remove it, and costs. The defendant did not enter an appearance.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1926.

23,293. "Universal electric motors." Burroughs Adding Machine Co. October 6th, 1925. (259,551.)

29,416. "Coupling circuit to be employed in transmitting and receiving speech, music, and the like over electric lighting or power mains or services whether the current is on or off." D. O. N. Evans. November 22nd, 1926. (287,597.)

31,897. "Electric switches for motor-cycle lamps and the like." British Thomson-Houston Co., Ltd., A. G. Salisbury and A. P. Young. December 16th, 1926. (287,610.)

32,298. "Electrical soldering irons or devices." A. O. Basson. December 21st, 1926. (287,616.)

32,413. "Wireless apparatus." C. H. P. Nutter and J. E. A. Hurd. December 22nd, 1926. (287,621.)

32,426. "Radiators, particularly for electric transformer tanks." British Thomson Houston Co., Ltd., and R. Dumas. December 22nd, 1926. (287,624.)

32,427. "Terminals or connections for electric conductors." British Thomson-Houston Co., Ltd., J. H. Pollard and E. G. Parrot. December 22nd. 1926. (287,625.)

32,544. "Devices for the interconversion of mechanical and electrical vibrations." British Thomson-Houston Co., Ltd., A. P. Young and J. Hutt. December 23rd, 1926. (Cognate application 19,151/27.) (287,631.)

32,584. "Apparatus for rectifying alternating currents." Westinghouse Brake & Saxby Signal Co., Ltd. January 23rd, 1926. (264,809.)

32,601. "Brush-holders for dynamo-electric machines." G. H. Fletcher and Metropolitan-Vickers Electrical Co., Ltd. December 23rd, 1926. (287,638.)

32,635. "Television and telephotography." B. Ritcheouloff. December 24th 1926. (287,643.)

1927.

744. "Production of mechanical or electrical energy." J. F. Gill and J. N. Chaviara. January 10th, 1927. (287,657.)

965. "Electrically heated boot-trees." G. E. Perkins. January 12th, 1927. (287,660.)

1,280. "High-frequency electrical apparatus." W. J. Brown and Metropolitan-Vickers Electrical Co., Ltd. January 15th, 1927. (287,663.)

1,600. "Storage batteries." D. P. Battery Co., Ltd., B. M. Drake and J. Waddell. January 19th, 1927. (287,666.)

2,566 "Method of and apparatus for securing secrecy in telephonic communications." W. B. H. Carr. January 28th, 1927. (287,673.)

2,682 "Dynamo-electric machines." W. Mackie & Co., Ltd. and J. Kook. January 29th, 1927. (287,674.)

2,742. "Dry batteries." Siemens Bros. & Co., Ltd., and H. A. Postlethwaite January 31st, 1927. (287,675.)

3,346. "Operating mechanisms primarily for electric switches." British Thomson-Houston Co., Ltd., W. P. Hamlyn and M. C. I. Hunter. February 5th, 1927. (287,677.)

3,358. "Conduits for laying electric cables." C. J. Beaver and W. T. Glover & Co., Ltd. February 5th, 1927. (287,679.)

3,561. "Induction regulators for controlling alternating-current motors." Electro Dynamic Construction Co., Ltd., and N. Pensabene-Perez. February 8th, 1927. (287,684.)

4,070. "Electrical condensers." Siemens Bros. & Co., Ltd., S. H. Long and C. R. Riber. February 14th, 1927. (287,686.)

5,593. "Means for converting electrical energy into light variations applicable for use in picture telegraph, television and like systems." Telefunken Ges. fur Drahtlose Telegraphie. March 1st, 1926. (266,753.)

6,281. "Motor-car headlights and the like." T. D. Suddards and E. Suddards. March 7th, 1927. (Cognate application 9,638.) (287,700.)

6,508. "Rectifying apparatus for alternating electric current." J. E. Lilienfeld. March 27th, 1926. (268,319.)

6,841. "Liquid heater or the like." Hotpoint Electric Appliance Co., Ltd., and W. J. Sims. March 11th, 1927. (287,704.)

7,546. "Medical instrument for magnetic treatment." T. Fujiyama. March 18th, 1927. (287,711.)

8,091. "Electrical switches." R. T. Waite. March 24th, 1927. (287,713.)

8,698. "Two-dial electricity meters for the measurement and control of more than one circuit." G. Wilkinson. March 30th, 1927. (287,718.)

9,395. "Electric switches." Ritter Dental Manufacturing Co., Inc. November 20th, 1925. (Divided application on 261,774.) (268,842.)

9,595. "Apparatus for rays for medical purposes." W. A. E. Crombie. April 7th, 1927. (287,724.)

11,557. "Metering arrangements for use in connection with telephone systems." Telephon-und Telegraphen-Fabrik Akt. Ges. Kapsch und Sohne. October 6th, 1926. (278,658.)

11,868. "Electric cells." G. E. Webster and Edison Swan Electric Co., Ltd. May 3rd, 1927. (287,741.)

12,187. "Electric switch." J. E. Long. May 6th, 1927. (287,742.)

15,692. "Means for tapping intermediate voltages from accumulator batteries." E. Baumer. June 13th, 1927. (287,750.)

16,699. "Electric insulator suspension devices." J. W. Hofmann. June 23rd, 1927. (287,753.)

18,449. "Net-cathode for electrolytic cells." A. Ergang. July 11th, 1927. (287,760.)

18,723. "Method of and means for signalling meter readings electrically." Siemens & Halske Akt. Ges. July 15th, 1926. (274,484.)

19,043. "Producing metals by electrolysis." E. C. R. Marks (Kemet Laboratories Co., Inc.). April 20th, 1927. (Divided application on 287,734.) (287,762.)

19,308. "Electric signalling installations for vehicles." Soc. Anon du Cligno-signal. July 30th, 1926. (275,218.)

19,377. "Ironless induction furnaces or heating apparatus." Siemens and Halske Akt. Ges. July 24th, 1926. (274,888.)

20,081. "Ironless induction furnaces or heating apparatus." Siemens and Halske Akt. Ges. July 29th, 1926. (Addition to 274,888.) (275,249.)

22,282. "Current rectifiers." L. Levy. August 24th, 1927. (Addition to 265,682.) (287,778.)

22,820. "Apparatus for making visible piezo-electrical resonance oscillations." H. Eberhard and Radio-Frequenz Ges. September 2nd, 1926. (277,002.)

23,651. "Method of and means for demagnetising alternating-current dynamo-electric machines." Siemens-Schuckertwerke Akt. Ges. September 22nd, 1926. (277,954.)

24,543. "Brush-holders for dynamo-electric machines." L. Schunk, H. Ebe and J. Schwalm. September 15th, 1927. (Addition to 275,989.) (287,792.)

25,153. "Sparking plug." C. V. Allenspach. September 23rd, 1927. (Convention date not granted.) (282,008.)

25,764. "Electric lamps, holders and sockets therefor." M. Charles. September 30th, 1926. (278,373.)

25,848. "Bushing terminal conductors." British Thomson-Houston Co., Ltd. October 2nd. 1926. (278,377.)

25,993. "Testing arrangement for telephone systems. Siemens & Halske Akt. Ges. October 15th, 1926. (279,063.)

26,594. "Calibrating arrangement for determining direction in wireless telegraphy on board ships." Nederlandsche Telegraaf Maatschappij Radio Holland. October 7th, 1926. (278,743.)

26,977. "Electrically insulating composition of matter for the construction of partitions and the like." I. G. Farbenindustrie Akt. Ges. November 6th, 1926. (280,178.)

28,262. "Micro-telephones." Siemens & Halske Akt. Ges. October 27th, 1926. (279,848.)

28,716. "Wireless receiving apparatus." A. Cianchi. October 28th, 1927. (Convention date not granted.) (287,805.)

29,787. "Driving gear for electrically-driven locomotives." J. Buchli. November 7th, 1927. (Addition to 273,507.) (287,808.)

31,386. "Hornless loud speakers." F. Brinkmann. June 24th, 1927. (287,815.)

34,082. "Electrical heating elements." Santon, Ltd., and H. C. Sanders. July 8th, 1927. (Divided application on 283,312.) (287,828.)

35,140. "Electrical signal receivers particularly for use in telephone systems." Telefonaktiebolaget L. M. Ericsson. January 4th, 1927. (283,135.)

1928.

4,247. "Insulating joints for cable sheaths." British Thomson-Houston Co., Ltd. February 25th, 1927. (285,902.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from April 11th:—

Firefly. No. 488,643. Class 13. Sparking plugs.—Wild & Dennison, Sun Motor Works, Henshaw Street, Oldham.

Corquest No 488,751. Class 13. Switches in the form of ordinary metal rings for attachment to the steering wheels of motor vehicles for the purpose of operating the electric horn.—Arnold Thomas, 3, New Street, Birmingham.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ALVERSTOKE.—Reconstruction of premises, for National Children's Home.

BARROW.—Secondary school (£26,158); Rainey Bros., Ltd., contractors.

BECKENHAM.—School, Elmers End housing estate; J. R. Hambridge, secretary.

BEDDINGTON AND WALLINGTON.—Houses (100), Elm Grove Estate, for C. R. Leech.

BIGGLESWADE.—Wesleyan Church, Muggerhanger; trustees.

BILLERICAY.—School, Dunton site (£4,292); T. J. Bailey, Chelmsford.

BIRMINGHAM.—Extension of the Central Technical College; Director of Education.

BLACKBURN.—Garages and workshop, Whalley Range and Ward Street, for H. Drummond. Hall, Freckleton Street, for trustees, Oxford Hall. Offices, Northgate, and Higher Croft, for G. Redsdale. Extension of mill, Dewhurst Street, for Barker, Marsh & Co. Extension of Greenbank Gasworks (£53,000); borough gas engineer.

BRIERLEY HILL.—Housing scheme (500 to 600), for the U.D.C.; surveyor.

BROMLEY (Kent).—Church, Hayes Lane; Smee & Houchin, architects, Fleet House, Fleet Street, E.C.4.

CHELMSFORD.—Extensions, for Marconi's Wireless Telegraph Co., Ltd.; C. W. Charlesworth, manager.

CHESTERFIELD.—Additional 34 houses for the T.C.; W. A. Derbyshire, architect, 30, Gluman Gate (deposit of £1 1s.). Additions, premises in West Bars and Chatsworth Road; Chesterfield Co-operative Society, Ltd. 'Bus station, Tontine Road; United Automobile Services, Ltd. Workshop and warehouse, Silkmill Yard; W. Yeomans. Church, Boythorpe Estate; Church of England authorities.

COATBRIDGE.—School, for Lanarkshire E.C.; John Stewart, master of works, 20, Albert Street, Motherwell.

DARTFORD.—Additional 30 houses for the R.D.C.; surveyor.

DERBY.—Primitive Methodist Church, Chaddeston Park, for trustees, First P.M. Circuit.

DONCASTER.—Central school, for the borough E.C.; Director of Education.

DOVER.—Additional 50 houses for the T.C.; borough surveyor.

DUMBARTONSHIRE.—New church hall at Scotstoun (£5,000); minister, Scotstoun Parish Church.

DUNDEE.—Commercial College; R. Gibson, architect, 2, India Buildings.

EARBY.—New St. Patrick's Roman Catholic church, Salterforth Lane (£3,500); Mullen & Durkin, Ltd., builders, Burnley.

EASINGTON (Co. Durham).—Additional 70 houses for the R.D.C.; surveyor.

EASTLEIGH AND BISHOPSTOKE.—Council offices with electrical work (£9,849), for the U.D.C.; Building and Public Works Construction Co., builders, Swindon.

EASTRY (Kent).—Nurses' Home (£3,000), for the B.G.; F. A. Cloke, clerk.

EDINBURGH.—Mission hall at Logie Green Road for City Mission; the superintendent. Additions and alterations at St. Margaret's Parish Church, Prospect Terrace; the minister.

FAVERSHAM.—Houses (22), for the T.C.; Whiting Bros., builders, Ospringe.

GLASGOW.—Conversion of Lennox Castle into hospital for Glasgow Parish Council; the clerk. Completion of Mearnskirk sanatorium (£280,000); city engineer. Extensions, Mitchell library (£3,500); city engineer. Boiler plant, Provan chemical works; gas engineer.

GRANTHAM.—Catholic day school (£3,527); Brown & Co., builders.

GRAYS.—Hostel (£6,000), Grays Palmer Endowed School for Girls; Essex county architect.

GUILDFORD.—Business premises, High Street, for Montague Burton, Ltd., Leeds. Waterworks pumping station (£11,873), for the T.C.; Thomas & Edge, builders, Woolwich.

HAMPTON.—Works additions, Oldfield Road; Hall & Hall, Welfare centre, Station Road; U.D.C. surveyor.

HELENSBURGH.—Shops and restaurant to accommodate 500 people; Major Macfarlane, Seafield, Cardross.

HIGH WYCOMBE.—Business premises, lighted by electricity, for Caleb Bridger, Easton Street (£6,000).

HULL.—Central library extension; J. Watson, quantity surveyor. Migration training hostel; Lord Mayor.

IRISH FREE STATE (Cork).—Houses (152), Evergreen site; Chillingworth & Levie, architects.

(Dublin).—Civil Service Commission premises (£90,000); G. W. Scott & Co., Usher's Quay.

KENILWORTH.—Housing scheme (24), for the U.D.C.; Sholto Douglas, surveyor.

KNUTSFORD (Cheshire).—Houses (50), for the North-West Counties Development Co.

LEEDS.—Reservoir, Middleton (£10,000); Paul Rhodes, Ltd. Dressing rooms, City Theatre of Varieties, Swan Street; licensee. Elementary school, Bentley Lane; city architect.

LEICESTER.—New Holy Cross Roman Catholic Priory Church (£20,000), for the Dominican Fathers.

LIVERPOOL.—Presbyterian Church, Woolton Road (£15,000); trustees.

LONDON (Walthamstow, E.).—Library and school centre at old buildings of Monnox Grammar school; U.D.C. surveyor.

(Highbury, N.).—Working boys' and girls' hostel, for National Children's Home.

(Wimbledon, S.W.).—Alterations, Holy Cross Convent, Southey Road; Norris & Shattock. Factory extension, Spencer Hill Road; R. J. & J. S. Thomson. Clinic and welfare centre, Pelham Road; F. H. Doel, of Merton. Twenty-eight houses, Merton Hall Gardens Estate; H. Coombs & Sons. Classrooms and dining hall, King's College School, South Side; A. Stratton. Showroom and offices, Hartfield Road; North, Robins & Wilson.

MIDDLESBROUGH.—Extension of North Riding Infirmary (£9,000); secretary.

MOLESEY (Surrey).—Houses (60), for the U.D.C.; East Kent Building Co., builders, Folkestone.

MOTHERWELL.—Housing scheme (80), for the T.C.; burgh surveyor.

PAISLEY.—New halls for Middle U.F. Church; Rev. John McKinnon, Middle U.F. Church.

PORTSMOUTH.—College buildings, London Road, Hilsea; J. E. Jones.

PRESTWICH.—Wesleyan church, Rooden Road; Heaton Park Wesleyan Church trustees. Showrooms, stores, and cabinet-making workshops, Bury Old Road; Jones and Rawlinson. Additions, Soap W[illegible]ks, Kersal Lane; Cussons, Sons & Co., Ltd.

PUDSEY.—Housing scheme (116), (deposit [illegible]); B. H. Noble, borough surveyor, Town Hall.

RIPON.—Housing scheme (34), for the T.C.; city engineer.

ROTHERHAM.—Re-building Grey Horse Inn (£5,500), H. L. Tacon, architect. Additional 276 houses for the T.C.; borough surveyor.

SLOUGH.—Three-storey furniture store, High Street, for J. Isaacs.

SPRINGFIELD.—Extensions, Mental Hospital (£6,073), for Middlesex C.C.; W. H. Gaze & Sons, Ltd., builders, Kingston-on-Thames.

STOCKTON-ON-TEES.—Bazaar premises, High Street, for F. W. Woolworth & Co., Ltd., Kingsway, W.C.2.

STRANRAER.—Hall at Kirkcolm; Messrs. John Forsyth and Son, contractors, Stranraer.

STRETFORD.—Showrooms, Trafford Park; Ford Motor Co. (England), Ltd.

SUTTON-IN-ASHFIELD.—Housing scheme (56), for the U.D.C.; Warner, Bocock & Dean, architects, Mansfield Road (returnable deposit of £3 3s.).

SUTTON (Surrey).—Houses (137), Ridge Estate, for J. E. Clark.

SWANSCOMBE.—Thirty-four houses, Church Field Estate; U.D.C. surveyor.

TORQUAY.—Houses (42), Shiphay, for A. Chippendale.

TRURO.—Town Quay improvements; city engineer. Twenty houses, Hendra; city engineer.

WAKEFIELD.—Extension, maternity hospital, Blenheim Road; city engineer.

WATFORD.—Factory, Arterial Road; Kempster & Williams. Extensions, Girls' Grammar school (£26,678), for Herts. E.C.; director of education, Hertford. Municipal buildings (competition for designs); E. Vincent Harris, assessor.

WINCHESTER.—Extensions to electricity offices, for the T.C.; Cancellor & Sawyer, architects, Queen Anne Chambers (returnable deposit of £2 2s.).

WISHAW.—Workshop reconstruction, new showrooms, &c., for Messrs. J. T. McDonald, motor builders, Wishaw; the manager.